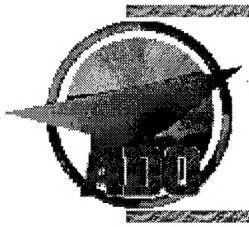

Army Digitization Master Plan

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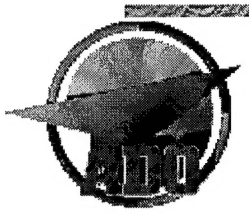

Army Digitization Master Plan (ADMP)

EXECUTIVE SUMMARY

"Shared situational awareness, coupled with the ability to conduct continuous operations, will allow information age armies to observe, decide, and act faster, more correctly, and more precisely than their enemies."

General Gordon R. Sullivan and Colonel James M. Dubik

The Army Digitization Master Plan (ADMP) provides the roadmap and the direction necessary to bring the capabilities of information age technology to the future battlefield. The ADMP addresses strategies, responsibilities, requirements, acquisition, experimentation methodology, joint and combined interoperability, and the management process that will transform the Army into a 21st century force (Force XXI). It provides the guidance necessary for developing, testing, and producing digital hardware and soft ware to meet the Force XXI requirements. By providing guidance designed to insure the seamless interoperability across the battlefield, the ADMP reflects the Army's recognition of the absolute necessity to develop and put in place an overall architectural framework for the battlefield that is based on well defined standards and protocols. It further details the manner in which the Army's battlefield digitization efforts are being coordinated within the Army and with other Services, our Allies, and other f oreign countries.

The ADMP is a living document that will be updated on an annual basis in synchronization with the Planning, Program, Budgeting, and Execution System (PPBES) cycle and after each major milestone. As digitization efforts mature, the ADMP will be refined and adjusted based upon the results of the extensive modeling, simulation and experimentation built into the program.

The Army digitization effort, as detailed in the ADMP, is a vital part of the larger process of redesigning the Army to meet the challenges of the 21st Century. The larger effort, called Force XXI, will encompass the reconceptulization and redesign of the force to enhance lethality, survivability, tempo, sustainability, deployability, joint/combined linkages, and versatility. The Army's intellectual and physical focus has shifted from Cold War/Industrial Age emphasis on increasingly complex and capable we apons systems to one focused on leveraging the power of our people, information, and technology.

Digitizing the battlefield entails the application of technologies to acquire, exchange, and employ timely information throughout the battlespace, tailored to the needs of each commander, shooter, and supporter. The objective of the Army digitization effort is to assure the superiority of our command and control system by providing warfighters with a horizontally and vertically integrated digital information network. This effort will insure a simultaneous, consistent picture of the battlefield from soldie r to commander at each echelon as well as insuring the Army is facilitating interoperability with its Sister services and Allied Forces.

Information is power. The commander who possesses it and uses it has a decisive advantage over an opposing commander who does not. Despite significant improvements brought about by automation efforts within specific battlefield operating systems, such as in fire support and military intelligence, the current method of distributing critical, time-sensitive information across the battlefield has not changed. For example, battlefield reports are currently passed upward from the lowest tactical level by voic e radio when a brief pause in the battle allows time to forward the report.

radio when a brief pause in the battle allows time to forward the report.

Figure 1

The effectiveness of digitization can be shown by considering the following example. On a digitized battlefield, a tank triggers his laser range finder on the lead vehicle of an approaching enemy. The global positioning system (GPS) equipped tank "knows" its own location, determines the range and azimuth to the target, and can immediately compute the coordinates of the enemy. This information is automatically placed in a spot report message that the tank commander or platoon leader calls up on his scre en. This message is transmitted over the digital radio to the company commander. This near instantaneous (seconds instead of minutes) transfer of information provides the commander with a more complete picture of his battlespace, enabling him to quickly direct his subordinates, getting every shooter into the fight, and making maximum effective use of the direct and indirect fires available to him. The enemy location information can be easily transferred to a call-for-fire (CFF) message template that a tan k commander calls up on his screen. The CFF message is then transmitted over the digital radio to the fire direction center which automatically begins the decide, detect, and deliver targeting sequence. The firing unit is then alerted. The targeting information is processed while simultaneously being routed into the intelligence database. If a firing platoon is in position waiting for a CFF, rounds can be in the air within 45 seconds of the original CFF sent by the tank. All of this can be done without voice transmission.

Force XXI will complete the transition from a threat-based force to a knowledge and capabilities based force. The campaign to achieve this end is being conducted in three parallel efforts called axes: redesign of the Operating Force (Joint Venture); redesign of the Institutional/TDA Army (Deputy Chief of Staff for Operations and Plans); and acquisition and assimilation of Information-Age Capabilities (Army Digitization Office). All three efforts are being coordinated by the Deputy Chief Staff for Operatio ns and Plans (DCSOPS). These efforts will provide the information necessary to guide fielding and associated organizational and operational decisions for Force XXI.

Figure 2

It is the acquisition and assimilation axis, being orchestrated by the Army Digitization Office (ADO), which will provide for the introduction of modern information technologies throughout the force. It is to this axis that the term "digitization" is applied. To insert or retrofit a new technology onto the Army's substantial equipment inventory is a massive undertaking. To accomplish this task, the ADO was established in July 1994 to oversee and coordinate the integration of Army battlefield digitizati on activities. The ADO balances the operational requirements generated by the US Army Training and Doctrine Command (TRADOC) and technical requirements developed by the Director of Information Systems for Command, Control, Communications, and Computers (DISC4) with emerging system technologies from the Army Materiel Command (AMC) to enable the Army to evolve into Force XXI.

While the ADO works with the research, development, and acquisition community to develop the operational, technical, and systems architectures necessary to field operational, interoperable, and cost effective digital hardware and software, Joint Venture is working to define the future doctrine, training, leaders, organizations, materials and soldiers (DTLOMS) capabilities that will be put into place in the Force XXI Army. Simultaneously the TDA/Institutional axis focuses on the concept, processes, and desi gn of the institutional Army and its sustaining base. DCSOPS is synchronizing the three axes to ensure a seamless linkage from the factory to the foxhole is achieved.

Joint Venture includes a series of Advanced Warfighting Experiments (AWEs) that will support decisions related to the redesign of the operational Army. These AWE's will also provide the key mechanism for evaluating the effectiveness of the information technologies being developed under the digitization axis. Two 1994 events, Desert Hammer and Desert Capture III, have become the baseline for two AWEs to be conducted in 1995, Focused Dispatch and Warrior Focus. Preceding each AWE, a sufficient train-up time is provided for participating units to become proficient in the fielded digital capabilities and to refine tactics, techniques, and procedures. The critical event in 1997 is the AWE called Brigade Task Force XXI. Digitized division and corps command and control elements will be included in the Brigade Task Force XXI experiment to provide insights into division and corps operational concepts and organizational designs. In addition, constructive, virtual and live simulations as

operational concepts and organizational designs. In addition, constructive, virtual and live simulations as well as experience from curr ent operations will influence the Force XXI design decisions. This experimentation strategy will insure final decisions for redesign of the forces are informed decisions based on empirical data and information. A division level Battle Command Training Program exercise, called Division XXI AWE, will be conducted in FY98. The results of each AWE will be used to modify and update the rolling baseline for the next exercise. The ultimate outcome of this strategic process is an appropriately designed and equi pped Army to meet the challenges of the 21st century.

The Army's digitization efforts are requirements driven and based on a number of validated/evolving requirements documents. Notably, three key documents provide the foundation for the digitization concepts and requirements. These documents are the Horizontal Integration of Battle Command Mission Needs Statement, the Army Battle Command System Common Operating Environment/Common Applications Operational Requirements Document, and the Force XXI Battle Command Brigade-and-Below Operational Requirements Docum ent.

The Horizontal Integration of Battle Command Mission Needs Statement (HIBC MNS) establishes the baseline operational requirements for digitization of the battlefield and future command systems. The Joint Requirements Oversight Council validated the MNS on 10 January 1995. The objective of this MNS is broad in nature, intended to address the operational needs and provide the Army with the technical means to meet the battlefield command and control challenges of the 21st century.

The Army Battle Command System Common Operating Environment/Common Applications Operational Requirements Document (ABCS COE/CA ORD) further defines the operational capability needs defined in HIBC MNS. It defines the need for a common operating environment (COE) for common applications(CA). It is currently being developed by TRADOC. This operational requirements document calls for the migration of current separate Army command and control component systems into one integrated system. Its purpose is to merge existing capabilities and requirements into on integrated battle command system from individual squad/platform through strategic levels.

The Force XXI Battle Command Brigade-and-Below Operational Requirements Document (FBCB2 ORD) also further refines the operational capability needs defined in the HIBC MNS. It defines the need for the lowest level command and control interface capability to the Army Battle Command System and standardizes the components of that capability. This document is currently being developed by TRADOC and will continue to evolve through the experimentation process. Further refinement will be done in coordination wi th the Air Force and Marine Corps based upon experimentation results.

Figure 3

To achieve the capabilities defined in the requirements documents, an Army Digitization Campaign Plan has been developed. The execution of this campaign plan will be conducted in four thrusts: 1) acquisition, 2) development of the "Tactical Internet", 3) integration of all operating systems, and 4) evolution of the Battlefield Information Transmission System (BITS).

A key aspect in providing digital capability to Force XXI is the acquisition of a digital capability for lower echelon forces. This effort, Force XXI Battle Command Brigade-and-Below (FBCB2), will equip platforms which lack an embedded digital capability with a laptop-sized computer -- the applique -- and provide the common software to link them together and to the command and control systems at echelons Brigade through Corps. The initial set of appliques will be used primarily for situational awareness a nd operational control. Three hardware variants are being acquired: Commercial-Off-The-Shelf (COTS), ruggedized, and militarized. Embedded systems currently providing digital functions and processes may require upgrading to host the common software for participation in the various AWEs.

The second thrust is integrating the various battlefield communication systems through the use of widely used Internet protocols and routers into the Tactical Internet. This integration will provide the battlefield users with a seamless communications capability and permit data transfers to access all available communications systems. The initial "Tactical Internet" will consist of the Single Channel Ground and Airborne Radio System (SINCGARS), Enhanced Position Location Reporting System (EPLRS) radios, a nd Mobile Subscriber Equipment/Tactical Packet Network (MSE/TPN). In the near-term, these three communication systems will be combined through translator "gateways" to form a complete, seamless

communication systems will be combined through translator "gateways" to form a complete, seamless system for the initial brigade-sized task force and division digitization experiments.

Thrust 3 focuses on assuring that the digital capabilities provided via the applique hardware and software are integrated with other information and weapons systems on the battlefield. It entails assuring that data elements, message standards, and communication protocols are common across all platforms that must exchange information. In some cases, this will require upgrading embedded systems so they can implement these common elements. The underlying strategy is the promulgation of a common standards-ba sed Technical Architecture and common software modules. The Army is committed to migrating to the Global Command and Control System Common Operating Environment (COE), not only at echelons above corps, but also for the tactical command and control systems. Where necessary, the Army, in concert with the Defense Information Systems Agency (DISA), will extend the Joint COE to support requirements for battlefield C2 systems and accommodate the processing constraints of embedded and hand-held digitized systems .

Thrust 4 is concerned with the Battlefield Information Transmission System. While the "Tactical Internet" will substantially improve communications connectivity, the digital data load of the future is expected to exceed the capacity of this network. Experiments will be conducted with commercial technologies, such as direct broadcast satellites and digital cellular phones.

To achieve the vision and goals of Force XXI, all battle command systems must be flexible and interoperable. The supporting battle command information infrastructure must support the ability to structure a force rapidly and efficiently to meet any future contingency. The capability to seamlessly transfer information across all the tactical Battlefield Operating Systems and from the lowest to highest echelon of command is dependent on having in place a well defined standards and protocols based set of arch itectures. The overall integrated architectural framework for the digital battlefield is based on three separate and distinct architectures. These three architectures, as defined by the Army Science Board, are the Technical, Operational, and System Architectures. The Operational Architecture says what to build, the System Architecture says how to build it, and the Technical Architecture states the rules and standards to follow.

Developing and implementing these architectures will result in fully interoperable Army systems, but that is not enough to meet the goals of Force XXI. The Army fights as part of an air, sea, space, and land team. As part of the team it must have the capability to exchange information with units from other services as easily and effectively as it does between Army units. The Army's approach to focusing on attaining Joint interoperability on the digitized battlefield has three components. First, the key t o achieving the required interoperability is the development and implementation of the Technical Architecture. The ADO is aggressively coordinating Army efforts to ensure that the Army Technical Architecture for information systems is in full compliance with the provisions of the DoD Technical Architecture Framework for Information Management (TAFIM), which serves as the common technical architecture of the Joint community. Second, the Army Digitization Office will closely coordinate its digitization effo rts - to include the review and approval of information standards and data transport profiles - with its sister services, the Joint Staff, and OSD through memorandums of agreement and proactive participation in Joint working groups and pertinent panels of the Military Communications-Electronics Board (MCEB). To ensure senior level involvement from the other Services, the Horizontal Technology Integration General Officer Working Group, chartered by the Army to oversee technology insertion into the Army, wil l invite appropriate flag rank personnel from the sister Services when Joint interoperability issues are scheduled for discussion. Third, other Services will be invited to participate in planned experiments, such as AWEs and BLWEs. These experiments will be used to address, evaluate, and resolve interoperability effectiveness issues.

Finally, the Army's digitization efforts fully embraces and supports the Joint Staff developed "C4I for the Warrior" concept. To accomplish the goals of this concept, each Service has implemented a framework to achieve Joint interoperability within the DoD guidelines. The Army's framework is called "The Enterprise Strategy." Battlefield digitization is one of the ten principles of this strategy and will ensure that the Warfighter will have information superiority over any opponent. The ADMP guides Army efforts in support of this principle and reinforces the overall Army Enterprise Vision.

Tomorrow's smaller Army must be an effective and lethal force with every decision maker deciding, every shooter shooting, and every supporter supporting in a synchronized manner and enabled by rapid, complete, and interoperable (Army, Joint, and Combined) digital information systems.


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Army Digitization Master Plan (ADMP)

CHAPTER 1 - INTRODUCTION

1.0 INTRODUCTION

1.1 Army Digitization Master Plan (ADMP) Purpose

The Plan

The ADMP supports the introduction of information technologies as the Army transforms to a 21st century force (Force XXI). Specifically, the ADMP addresses Force XXI strategies, responsibilities, requirements, acquisition, experimentation methodology, management processes, and the manner in which coordination of the digital battlefield is being carried out within the Army, other Services, and our Allies and friends.

A Living Document

The ADMP is a living document. The Army Digitization Office (ADO) will update the ADMP with each Planning, Programming, Budgeting, and Execution System (PPBES) cycle and after each implementation milestone.

1.2 Force XXI and Digitization

The Vision

The Army digitization effort is a vital part of the larger Army process for meeting the challenges of the 21st century. The Industrial Age is being superseded by Force XXI. Accordingly, the Force XXI Campaign Plan describes three main axes for modernization of the force: redesigning the Table of Distribution and Allowances (TDA)/Institutional Army, redesigning the operational Army through Joint Venture, and integrating modern information technology through the ADO (see figure 1-1).

Figure 1-1 Three Axes

The Louisiana Maneuvers Task Force (LAMTF) synchronizes the efforts of these three axes and provides the means for senior Army leadership to focus on critical issues, make policy decisions, and guide the allocation of resources.

Joint Venture Axis

Joint Venture redesigns the operational Army. It is a partnership effort led by the Commanding General, US Army Training and Doctrine Command (TRADOC), in conjunction with the Army Major Commands (MACOMs) and the Army Staff (ARSTAF). The intent of Joint Venture is to provide a framework to assess operational capabilities and guide future doctrine, training, leader development, organizations, materiel, and soldiers (DTLOMS). It serves as the basis to develop the capability of Army forces to conduct su ccessful operations under Joint command and win battles in modern, knowledge-based warfare. Joint Venture will examine organizational tactics, techniques, and procedures (TTP), and technology alternatives that will enhance the lethality, survivability, and battle command capabilities of the operating forces.

TDA/ Institutional Army Axis

The TDA/Institutional axis, led by the ARSTAF, focuses on the concept, processes, and design of

the institutional Army and its sustaining base. Synchronization is necessary with the Joint Venture and the ADO axis to ensure a seamless linkage from the foxhole to the factory. These efforts aim at continuous improvement to the organization in order to meet the continuing challenges of an uncertain world.

Digitization Axis

The ADO axis provides for the introduction of modern information technologies throughout the force to optimize our capabilities. It is to this axis that the term "digitization" is applied. The ADO balances the requirements generated by TRADOC with the technology developed by the acquisition community to enable the Army to evolve into Force XXI.

The ADMP focuses on the execution of the ADO axis which requires assimilation of modern information technologies into the force. Iterative cycles of experimenting, learning, and deciding on modernization initiatives characterize the execution process. This is supported by streamlined acquisition processes that allow faster implementation of decisions.

1.3 Digitization Definition

Digitizing the battlefield is the application of technologies to acquire, exchange, and employ timely digital information throughout the battlespace, tailored to the needs of each decider (commander), shooter, and supporter. Digitization allows each soldier to maintain a clear and accurate vision of the common battlespace necessary to support planning and execution.

Digitization provides the warfighters a horizontally and vertically integrated digital information network that supports warfighting systems and assures command and control (C2) decision-cycle superiority. The intent is to create a simultaneous, appropriate picture of the battlefield from soldier to commander at each echelon.

This picture is based on common data collected through the network of sensors, command posts, processors, and weapons platforms. This allows participants to aggregate relevant information and maintain an awareness of what is happening around them, both friendly and enemy forces.

What Digitization Does

Digitization is an enabler to achieve interoperability internal to the Army as well as with sister Services and Allied forces. It helps the Army of the 21st century be more survivable and more lethal while executing at an increased tempo. Digitization allows the employment of forces in a highly mobile, synergistic, and overwhelming manner.

Digitization also makes possible the implementation of new DTLOMS allowing domination of the battlefields, just as the implementation of AirLand Battle's DTLOMS was a keystone ingredient to the Army's success in the deserts of southern Iraq.

Establishment of the ADO

To accomplish the digitization goal, the Department of the Army (DA) Digitization Special Task Force (STF), formed in January 1994, developed an initial digitization strategy for the force and created the nucleus of the ADO. Established in July 1994, the ADO oversees and coordinates the integration of Army battlefield digitization activities. The ADO's extended membership includes doctrinal thinkers, technical experts, procurement officials, and representatives working together with industry to capita lize on information-age technology.

ADO Role

The ADO is the Vice Chief of Staff of the Army's (VCSA's) instrument for digitization activities across the major commands. Likewise, the ADO is the Army Acquisition Executive's (AAE's) instrument for providing guidance, assistance, and coordination in acquisition matters related to digitization.

The ADO is specifically charged with advising the VCSA and AAE on all matters concerning the

integration of digital capabilities across the force and overseeing the integration of Army digitization activities consistent with the AAE's and Chief of Staff of the Army's (CSA's) vision. The ADO maintains the ADMP and monitors Army-wide digitization integration to ensure consistency with the Master Plan. The ADO uses a digitization Management Decision Package (MDEP) as an oversight mechanism to integrate d evelopment activities. Additionally, the ADO develops acquisition strategies to support the strategic direction provided by the Army leadership.

1.4 Horizontal Technology Integration (HTI)

Relationship to HTI

HTI is a key component of the modernization strategy essential to effective system upgrades and that capitalizes on new technology in near-to-mid term. It is the simultaneous integration of complementary technologies into families of systems that fight and operate together on the battlefield. Integrating complementary technologies into every combat system in a unit creates a synergy that gives unit greater combat power sooner than would upgrading in the old manner - a system at a time across the entir e force. HTI increases the combat power of the Army a unit at a time with priority given to the contingency forces, the first to be deployed. This maximizes the combat power of those forces sooner, honing the spearhead of any force the Army must deploy.

There are three HTI initiatives: Digitization, Battlefield Combat Identification System (BCIS), and the Second Generation Forward Looking Infra-red (FLIR) system. BCIS and Second Generation FLIR, while not part of the digitization effort, are closely monitored to ensure the necessary linkages for generated data are maintained and redundancies eliminated.

Figure 1-2 Overmatching Technology Strategy for the 21st Century

HTI breaks away from traditional stovepipe processes of individual system requirements and looks instead at the overall force requirements on the battlefield. HTI integrates dissimilar weapon systems (e.g., tanks, infantry fighting vehicles, armored vehicles, artillery, aircraft, command and control vehicles, etc.) with common technology through either new acquisitions, pre-planned product improvements (P3I), or system-component upgrades (also see Annex L).

1.5 Army Enterprise Strategy

Relationship to Enterprise Strategy

The Army Enterprise Strategy (Vision and Implementation Plan) details the Army implementation of the Command, Control, Communications, Computers and Intelligence (C4I) for the Warrior Vision established by the Office of the Joint Chiefs of Staff. Battlefield digitization is one of the ten principles of the Army Enterprise Strategy that assures the Warfighter will have information superiority over any opponent. Other supporting Enterprise principles to battlefield digitization are: optimization of the information technology environment, ensuring joint interoperability, acquiring integrated systems using commercial technology, and exploitation of modeling and simulation. The ADMP guides near-term applique development, reinforces the Army Enterprise Vision, and focuses institutional developments, redesign of the operational Army, and the integration of modern information technology into Army forces. The Army Enterprise Strategy Implementation Plan specifically supports the requirements of Force XXI throu gh identification of tasks for development of Operational, Technical, and System Architectures.

1.6 Responsibilities

The nature and aggressive time schedule of the Army digitization effort require the coordinated actions of all agencies involved to successfully accomplish modernization objectives. The following is a listing of the primary partners in this process and their responsibilities related to digitization.

Assistant Secretary of the Army for Research, Development and Acquisition (SARDA)/Army Acquisition Executive (AAE)

SARDA/AAE

The SARDA/AAE is responsible for:

- Sponsoring Advanced Technology Demonstrations (ATDs) that bring digital capabilities to a state of technical maturity, permitting their capabilities to be proven in Battle Lab Warfighting Experiments (BLWEs) and AWEs.
- Providing Army Staff-level planning, authorization, and funding support for Force XXI requirements.
- Serving as the Army Technical Architect.
- Coordinating digitization science and technology efforts with the Advanced Research Projects Agency (ARPA).
- Ensuring the digitization effort capitalizes on acquisition streamlining initiatives.
- Providing modeling and simulation support as appropriate for digitization.
- Coordinating Technical Architectures and Science and Technology efforts with Joint and DoD C4I agency Component Acquisition Executives (CAEs).

Deputy Chief of Staff for Operations and Plans (DCSOPS), Headquarters, Department of the Army

DCSOPS

The DCSOPS is responsible for:

- Integrating and synchronizing Army Staff efforts across all three axes of the Force XXI Campaign Plan, and leading the axis to re-engineer the TDA/Institutional Army in concert with Army Commanders.
- Adjusting the fielding schedules of programs, such as Army Tactical Command and Control Systems (ATCCS), and Tactical Radio Communications Systems, as required by the Experimentation Force (EXFOR).
- Ensuring digitization programs are prioritized consistent with CSA's goals to field a digitized force.
- Validating the Operational Architecture developed by TRADOC.
- Coordinating Land Information Warfare activities.
- Providing modeling and simulation support as appropriate for digitization.

Director of Information Systems for Command, Control, Communications and Computers (DISC4), Headquarters, Department of the Army

DISC4

The DISC4 is responsible for:

- Supporting the AAE by developing and maintaining the Army's Technical Architecture for both battlefield systems and installations with the support of Army Program Executive Offices (PEOs), Major Commands (MACOMs), and agencies.

- Ensuring Army Enterprise Strategy tasks are consistent with the Army's accepted definitions of Operational, Technical, and Systems Architectures.
- Exercising spectrum management responsibilities in support of the digitization efforts.
- Establishing Army policies for Multi-Level Security (MLS).
- Coordinating the Army's Technical Architecture with other Services.
- Providing modeling and simulation support as appropriate for digitization.
- Overseeing requirement developments for the Battlefield Information Transmission System (BITS).
- Overseeing data standardization efforts for Army and interface for Joint data standardization.

Army Digitization Office (ADO), Headquarters, Department of the Army

ADO

The ADO is responsible for:

- Overseeing and coordinating the integration and interoperability of Army battlefield digitization activities.
- Providing guidance, assistance, and direction in acquisition matters related to digitization.
- Applying streamlined acquisition procedures to emerging technologies in order to accomplish the Force XXI digitization objectives.
- Coordinating and synchronizing the efforts of combat and materiel developers to develop and deploy information technologies needed for the wide range of future military operations.
- Assuring the implementation of the digitization Technical Architecture is compliant with the Global Command and Control System (GCCS) Common Operating Environment (COE).
- Coordinating with the Joint Staff and Commanders-in-Chiefs (CINCs) on all ADMP matters that impact on maintaining interoperability of all Joint information exchanges.
- Coordinating with the Joint Staff and CINCs to ensure that all ADMP software programs and protocols, and Internet Protocol (IP) router plans and data rates for all Joint information exchanges remain interoperable.
- Maintaining the ADMP.
- Monitoring Army-wide digitization integration to ensure consistency with the ADMP.
- Advising the VCSA and AAE on all matters concerning the integration of digital capabilities across the force.
- ADO responsibilities are further documented in the charter signed by the VCSA and the AAE (Annex A).

US Army Forces Command (FORSCOM)

FORSCOM

FORSCOM is responsible for:

- Providing personnel and resources in accordance with FORSCOM/TRADOC FORCE XXI Experimental Force (EXFOR) and alignment of TRADOC Battle Labs with FORSCOM units Memorandums of Agreement (MOA).
- Providing feedback to the ARSTAF concerning the utility of fielded equipment associated with digitization.
- Assisting in design and review of Joint/Combined information exchange requirements.

US Army Training and Doctrine Command (TRADOC) Joint Venture

TRADOC

TRADOC is responsible for:

- Redesigning the operating force to be knowledge-based, modular in design, and tailorable in capability.
- Planning, coordinating, conducting, and analyzing AWEs and BLWEs to provide timely feedback for decisions of Force XXI design.
- Reviewing annual Total Army Analysis and Program Objective Memorandum for conformance with Army priorities stemming from Joint Venture experiments.
- Coordinating Joint Venture experiments and findings with other Services and Allies.
- Developing and documenting operational requirements associated with the Horizontal Integration of Battle Command (HIBC) Mission Needs Statement (MNS).
- Developing and updating the Operational Architectures.
- Defining, coordinating, and consolidating Joint and Combined information exchange requirements.
- Developing, in conjunction with the materiel developers, BLWEs that evaluate and refine the operational capabilities of new equipment and software from the Force XXI Battle Command Brigade-and-Below (FBCB2) contract, related ATDs and other digitization related development efforts.
- Aligning Advanced Concepts and Technology II (ACT II) BLWEs with digitization objectives.
- Developing programs (in conjunction with the FORSCOM, PEOs, and AMC), for training EXFOR personnel to operate and maintain the digital equipment.
- Defining Joint and Combined information exchange requirements in coordination with Joint Staff, CINCs, DISA and Joint Interoperability Test Center (JITC).
- Designing, resourcing, executing, and evaluating AWEs.
- Providing modeling and simulation support as appropriate for digitization.
- Developing criteria for evaluating the operational effectiveness for digitization.

US Army Materiel Command (AMC)

AMC

AMC is responsible for:

- Maintaining oversight of the Technical Information Architecture through matrix support to PEOs/Program Managers (PMs).
- Serving as the Army's Systems Engineer reporting to the Technical Architect for system engineering and technical architecture matters.
- Providing matrix systems engineering support to the Army Technical Architect and PEOs/PMs.
- Coordinating all information technology generation and application efforts as they relate to the Army digitization effort.
- Providing matrix support to the AAE and DISC4 for developing and maintaining the Army Technical Architecture by evaluating solicitations, proposals and system designs for compliance.
- Interfacing with Joint/Coalition technical agencies.
- Providing recommendations for updates to the Technical Architecture.
- Participating and influencing commercial standards and forms.
- Providing expertise in the latest information processing technologies.
- Evaluating hands-on commercial technologies.
- Establishing and maintaining the Digital Integration Laboratory (DIL) for the verification of prototype hardware and software to meet the functional and interoperability requirements.
- Providing modeling and simulation support as appropriate for digitization.
- Serving as the Army Executive Agent for international digitization efforts and technology sharing with Allies.
- Coordinating Platform Integration.
- Providing technical assistance, subject matter expertise, and material support to exercises and experiments.

US Army Space and Strategic Defense Command (SSDC)

SSDC

SSDC is responsible for:

- Coordinating the inclusion of space and missile defense capabilities into Force XXI.
- Providing space and Theater Missile Defense (TMD) mode modeling and simulation support as appropriate for digitization.

All Program Executive Offices (PEOs) and Program Managers (PMs)

PEOs/ PMs

All PEOs and PMs are responsible for:

- Providing periodic digitization reviews.
- Developing a plan to migrate to the DoD Technical Architecture.
- Providing modeling and simulation support as appropriate for digitization.
- Supporting the experimentation process.
- Accomplishing specified installation kit responsibilities.

Responsibilities for tasks associated with applique (digitization processing equipment added to vehicles) and communications systems installation kits will be split between the FBCB2 PM and the various platform PMs/Item Managers (IMs). The installation kits include mounting brackets, holsters, wires, and other similar items. The installation kits do not include line removable applique items. The following table depicts which PM has responsibility for each task. The FBCB2 Program will provide funding for these tasks.

Figure 1-3 Installation Kit Responsibilities

PEO Command and Control Systems (CCS)

PEO CCS

The PEO CCS is responsible for:

- Managing the acquisition of hardware, software, and systems engineering support for integrated command and control systems, with support from AMC.
- Managing the ADO system integration effort, with support from AMC.
- Preparing - in coordination with the ADO, an applique Experimentation Master Plan (EXMP).
- Developing the COE documentation.
- Providing modeling and simulation support as appropriate for digitization.
- Developing and enforcing the standards of COE.
- Preparing, in coordination with the ADO, a capstone EXMP which integrates the test programs of the following PEOs: COMM, CCS, ASM, Avn, MD and IEW.

PEO Communications (COMM)

PEO COMM

The PEO COMM is responsible for:

- Providing the communications infrastructure needed to support reliable, horizontal and vertical seamless connections. This includes the following networks: Enhanced Position Location Reporting System (EPLRS), Single Channel Ground and Airborne Radio System (SINCGARS), Joint Tactical Data System (JTIDS) and Mobile Subscriber Equipment (MSE); as well as the Marine Corps and Air Force communications equipment and commercial communication equipment.
- Managing the development of the tactical internet in accordance with Army's Technical

Architecture, with support from AMC.

- Defining the communications protocols and standards for COE.
- Providing modeling and simulation support as appropriate for digitization.

PEOs for Armored Systems Modernization (ASM), Aviation (Avn), Missile Defense (MD), Tactical Missiles (TM) and Intelligence and Electronic Warfare (IEW)

PEOs: ASM, Avn, MD, TM, IEW

The PEO ASM, PEO Avn, PEO MD, PEO TM, and PEO IEW are responsible for:

- Upgrading existing system computer processors, displays, radios, navigation equipment, and underlying software and computer operating systems consistent with the Army's System, Operational, and Technical Architectures.
- Providing modeling and simulation support as appropriate for digitization.
- Ensuring that protocols and systems interface with and incorporate the COE.

Major Commands (MACOMs)

MACOMs

MACOMs are responsible for:

- Coordinating digitization efforts with the ADO.
- Providing feedback on the utility of fielded equipment and perceived needs for DTLOMS enhancements based upon battlefield digitization.

US Army Operational Test and Evaluation Command (OPTEC)

OPTEC

OPTEC is responsible for:

- Providing an independent evaluation of the operational utility and suitability of digitization hardware and software.
- Planning for and participating in the entire spectrum of digitization field experiments.
- Providing a continuous and iterative suitability analysis to guide the development process and support acquisition decisions.
- Serving as the lead evaluation agency supporting the ADO.
- Establishing a rolling baseline to support digitization experiments.
- Providing modeling and simulation support as appropriate for digitization.
- Assisting in development of test plans and procedures for individual or phased efforts for Force XXI digitization AWEs, ABCs and COE applications and software tests.
- Reviewing and evaluating training needs and effectiveness.

Director, Louisiana Maneuvers Task Force (LAMTF)

LAMTF

LAMTF is responsible for:

- Maintaining the Force XXI Campaign Plan.
- Integrating and synchronizing all Force XXI efforts across the three axes of the Campaign Plan.

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Army Digitization Master Plan (ADMP)

CHAPTER 2 - DIGITIZATION REQUIREMENTS

2.0 DIGITIZATION REQUIREMENTS

2.1 Background

Weapon System Build-Up
In the 1980s, the Army fielded the Abrams tank, Bradley Fighting Vehicle (BFV), Apache attack helicopter, Multiple Launch Rocket System (MLRS), and Patriot Missile System. These investments, along with other new systems and improvements to then-existing platforms, made possible the design of new organizations and the implementation of a new doctrine—AirLand Battle. These revolutionary advancements were proven on the battlefields of the Gulf War. Their unequivocal success temporarily silenced the critics of the defense buildup that preceded Desert Storm.

Less Modernization in the '90s
For the remainder of the 1990s and into the beginning of the next century, the modernization program of the Army is not as robust as it was in the 1980s. With notable exception of the Advanced Field Artillery System (AFAS), there are few major programs scheduled for production. Incremental modernization of current weapons systems is planned.

Needed Capability
What is needed is another quantum surge in force capability. Interoperable digitization of the battlefield has the potential to provide the means for the next renaissance of military art and science, in the same manner that the infusion of digital technology into the American society is providing a transitional bridge from the Industrial Age to the Information Age.

2.2 Information Warfare

Information is power. The commander who possesses it and uses it has a decisive advantage over an opposing commander who does not have the most current information. Yet, the current method of distributing critical, time-sensitive information across the battlefield has not changed, despite significant improvements brought about by automation efforts within specific battlefield operating systems (BOS), such as in fire support and military intelligence.

Current Situation
Currently, spot reports are passed upward from the lowest tactical level by voice radio when a brief pause in the close-in battle allows time to forward the report. At the next echelon, the information is received by a radio operator who hand-copies it and aggregates it with other reports being simultaneously received; retransmitting it to the next higher command echelon as time permits. This time-consuming cycle is repeated at each succeeding level as the information gradually climbs upward within the hierarchical communications net structure which parallels the pyramidal organizational command layers. Time lag can be significant.

Passing the information laterally within the command structure or from one BOS to another is a

hit-or-miss proposition, based on the criticality of the information and the net loading occurring at that particular point in time. It is in the midst of battle, when information is the most critical and radio nets receive the highest loading factor, that the system tends to choke on the volume of traffic and receipt of vital information is often delayed. Tactical and operational windows of opportunity can be ex eedingly brief, based on the battlefield physics of time and space.

Digitization Expedites Information Flow
Passing of information digitally expedites the information flow and accelerates the decision making cycle. Information is more readily available to everyone with access to the network at the appropriate echelons. It dramatically decreases the time needed to convert a decision into execution, whether via a cryptic fragmentary order appearing on a tank commander's graphics display or a hasty "John Madden" operations sketch electronically received and transposed on top of a digital terrain map.

At the lower tactical levels, essential decision making needs can be very basic. The most often requested information on every command net consists of: Where are you? Where is the enemy? What are each of you doing?

Shared Situational Awareness
Shared situational awareness provides everyone with the same near-real-time picture of their relative battlespace. The company commander can see on his digital display where each of his elements are located, to include those out of the line-of-sight. In the same manner, the battalion commander can track his platoons, the brigade commander his companies, and the division commander his battalions. By means of a distributed database, the division can also portray the location of any single vehicle transmitting its position. By conversion to a network structure, the leader on the ground can also follow the progress of the units across his lateral boundaries, as well as those to his front, regardless of their unit affiliation. Maneuver operations can be more tightly synchronized while the instances of fratricide can be greatly reduced. At the same time, intelligence obtained from multiple sources is rapidly fused, analyzed, and transmitted, with enemy icons appearing on the same visual display.

Figure 2-1 Digital Capability

Battllefield Digitization Example
The effectiveness of digitization can be shown by considering the following example. On a digitized battlefield, a tank triggers his laser range finder on the lead vehicle of an approaching enemy. The Global Positioning System (GPS) equipped tank "knows" its location, the range and azimuth to the enemy vehicle, and can immediately compute the coordinates of the enemy. This information is automatically placed in a spot report message that the tank Platoon Leader calls up on his screen. This spot report is then transmitted over the digital radio to the company commander. This near instantaneous (seconds instead of minutes) transfer of information provides the commander with a more complete picture of his battlespace, enabling him to quickly direct his subordinates, getting every shooter into the fight, and making maximum effective use of direct and indirect fires available to him. The enemy location information can be easily transferred to a call-for-fire (CFF) message template that the tank Platoon Leader calls up on his screen. The CFF message is then transmitted over the digital radio to the fire direction center which automatically begins the decide, detect, and deliver targeting sequence. The firing unit is then alerted. The targeting information is processed while simultaneously being routed into the intelligence database. If a firing platoon is in position waiting for a CFF, rounds can be in the air within 45 seconds of the original CFF sent by the tank. All of this can be done without a voice transmission.

2.3 Value Added

To insert or retrofit a new technology onto the Army's substantial equipment inventory is a massive undertaking. The first question properly posed by programmers and budgeters is "What is the value added?". The Army's hypothesis is that a digitized capability will enhance force effectiveness, specifically in terms of improved lethality, survivability, and tempo. Early modeling

and simulation results have indicated that forces that can exchange information digitally can move more quickly and engage the enemy more decisively. The Army is structuring the Advanced Warfighting Experiments (AWE) to further test this hypothesis and will be collecting data to refine and, where possible, quantify the relationship between improvements in digitized capabilities and improvements in force effectiveness.

Empirical Data Needed
While the effect of digitization on the battlefield can be crudely modeled by decreasing response times and subjectively adjusting combat factors, modeling a totally new capability is always a daunting challenge. In the absence of hard, empirical data, the immediate answer is elusive. Without empirical data, analyses based on the results of simulations lack the degree of requisite credibility.

The necessary empirical data will be provided in the near and mid-term by a series of planned Advanced Technology Demonstrations (ATDs), Advanced Warfighting Demonstrations (AWDs), Advanced Concept Technology Demonstrations (ACTDs), and AWEs. They will serve as the technical and doctrinal testing grounds which will provide the updated foundation for the Army of the 21st century.

Specific BOSs can be isolated. For example, applying a higher artillery rate of fire and increased level of accuracy would be based on improved digital fire direction control and precise locations of observer, target, and firing unit. However, the synergism of similar technology-driven advances simultaneously occurring within multiple layers of each BOS in the conduct of the deep, close and rear battles requires far too many assumptions at this early stage of implementation.

Baseline studies and analyses as well as assessing the impact of digital technology using current tables of organization and equipment is an essential starting point for subsequent excursions. However, the ensuing rough estimate would measure future battlefield value using present warfighting means, and would ignore the baseline changes in doctrine and structure that would take place prior to fielding the digitized force. Attempting to apply several changes simultaneously in a predictive model would statiscally bury the marginal contribution of any one input and could result in incorrect conclusions.

2.4 Operational Requirements Documents (ORD) and Mission Needs Statement (MNS)

Requirements Documents
There is no single requirements document for digitization. Instead, the conceptual and requirement underpinnings on which digitization is built come from a variety of sources that include Mission Needs Statements (MNSs), Operational Concepts, Operational Requirements Documents (ORDs), and Policy Guidance and Regulations. The key documents for digitization are the Horizontal Integration of Battle Command (HIBC) MNS and the Army Battle Command System COE/CA ORD.

2.4.1 Horizontal Integration of Battle Command Mission Needs Statement (HIBC MNS)

Baseline Operational Requirements
The HIBC MNS establishes the baseline operational requirements for digitization of the battlefield and future command systems. It was approved by the Department of the Army and forwarded to the Joint Requirements Oversight Council (JROC) for validation in October 1994. The Defense Information Systems Agency (DISA) and J6 granted Command, Control, Communications, and Computers (C4) interoperability certification on 6 December 1994. The MNS was validated by JROC on 10 January 1995. MNS validation supports the expenditure of Task Force XXI Research, Development, Training, and Evaluation (RDTE) digitization funds. The operational baseline provides for:

- Capability to react on information faster than the enemy.
- Enhanced situational awareness at all levels.

- Rapid processing and transfer of information.
- Faster and more comprehensive access to intelligence data.
- Increased ability to synchronize direct and indirect fires.
- Means to establish and maintain an overwhelming operational tempo.

MNS Objectives
The objectives of the MNS are broad in nature, intended to address the stated operational needs and provide the Army with the technical means to meet the battlefield command and control (C2) challenges of the 21st century by:

- Providing commanders with a clear, near-real-time picture of their relative battlespace.
- Establishing Army Battle Command System (ABCS) database for expeditious information transfer.
- Exploiting state-of-the-art communications, sensors, and computers.
- Developing an integrated ABCS with:
- Horizontal integration among BOSs.
- Vertical integration among command echelons.
- Achieving battle command linkages among discrete C2 systems.
- Integrating weapons systems, command posts, sensors, and support systems.
- Devising standard, interoperable data exchange methods and protocols.
- Accomplishing Joint/Combined interoperability through migration to the Global Command and
- Control System (GCCS) and its common operating environment (COE) system.
- Interconnecting of digital terrain data and terrain visualization, fused with intelligence data, for graphic portrayal of battlespace and situational awareness.

Capability Constraints
The MNS does not describe a materiel solution but does establish a series of basic hardware and software constraints:

- Standard hardware to reduce costs and simplify maintenance.
- The use of modularity and an open architecture to facilitate ease of upgrades.
- The option of embedded or applique hardware—as appropriate to the system.
- A mix of commercial off the shelf (COTS), ruggedized, and military specification components.
- A Technical Architecture consisting of common applications, standards, and protocols.
- A user-friendly interface, permitting effective operation in a tactical field environment.
- Standard Defense Mapping Agency (DMA) digital map and terrain data as well as hasty data provided by Army topographic elements.
- Common graphics and tactical symbology.
- C2 of supporting operations on-the-move without degradation.
- Equipment capable of operating in the same battlefield, climate, and weather as the host platforms.
- A means to identify friend, foe, or noncombatant using sensor information and/or data sources.
- Meet Joint standards for Command, Control, Communications, Computers, and Intelligence (C4I) interoperability to interface seamlessly with GCCS.

The general capabilities are tailored to allow the smaller force projection Army to more efficiently and decisively concentrate battlefield "effects," rather than the massing of forces and firepower by traditional means. The intent is to enable contingency forces - comprised of fewer and smaller units - to be more lethal and survivable in an environment characterized by an accelerated operational tempo demanding instant communications and immediate response times.

2.4.2 Army Battle Command System Common Operating Environment/Common Applications Operational Requirements Document (ABCS - COE/CA ORD)

The ABCS-COE/CA ORD further refines the operating capability needs defined in the HIBC MNS. It defines the need for a common operational environment for common applications. It is being developed by the combat developer (TRADOC) with submission to the Department of the Army targeted for mid-January 1995 and approval projected by March 1995.

The draft ABCS-COE/CA ORD incorporates the requirements of the HIBC MNS and envisions the repackaging and consolidation of existing systems. The ABCS-COE/CA ORD calls for the migration of current separate Army C2 component systems into one integrated system. Its purpose is to merge existing capabilities and requirements into one integrated battle command system from individual squad/platform through strategic levels. The ABCS-COE/CA components are the Army Global Command and Control System (AGCCS), the Standard Theater Army Command and Control System (STACCS), and the Combat Service Support at Echelons Above Corps (CSS at EAC); the Army Tactical Command and Control Systems (ATCCS) consisting of: the Maneuver Control System (MCS), All Source Analysis System (ASAS), Combat Service Support Control System (CSSCS), Air/Missile Defense Tactical Operational System, and the Advanced Field Artillery Tactical Data System (AFATDS); and the Force XXI Battle Command Brigade-and-Below (FBCB2) system which has the functionality of systems at brigade and below such as the Brigade and Below Command and Control System (B2C2) and Inter-vehicular Information System (IVIS).

Figure 2-2 Army Command and Control Umbrella

ABCS Concept
ABCS is the integration of systems battlefield automation systems (BAS) and communications which functionally link strategic, operational, and tactical headquarters. It employs a mix of fixed and semi-fixed installations and mobile networks, depending on the subsystem. It is interoperable with theater, Joint, and Combined C2 systems across the full range of BOS functions, and is vertically and horizontally integrated at the tactical and operational levels.

Global Command and Control System (GCCS)

GCCS

The GCCS was designated the single C2 system for the Department of Defense (DoD). It is built within the framework of the:

- Technical Architecture for Information Managment (TAFIM) dated 30 June 1994;
- Technical Reference Model within the TAFIM;
- GCCS Integration Standard, dated 26 October 1994;
- GCCS User Interface Specification, Version 1.0, dated October 1994; and
- GCCS Common Operating Environment, dated 28 November 1994.

GCCS is the realization of "C4I for the Warrior" concept. GCCS improves the Joint Warfighter's ability to manage and execute crisis and contingency operations and provide a means to interface to Commanders-in-Chief (CINCs), Services/Agencies C4I systems for peacetime deliberate planning as well as crisis planning and execution. The concept builds upon lessons learned from previous conflicts, operational requirements, and the effects of rapidly changing technology.

Figure 2-3 Army Battle Command System

The Warfighter requires a seamless information system, where boundaries between functions and sources are erased. GCCS provides the seamless, integrated information to the Warfighter when, where, and how it is needed. This enhances Warfighter effectiveness by driving interoperability through the elimination of duplicated functionality and the convergence of Joint Warfighter doctrine via GCCS's encapsulation of common Command, Control and Intelligence (C2I) methods. GCCS uses the secret internet protocol network (SIPRNET) as its communications backbone.

The goals of the GCCS are:

- For all CINCs, provide one affordable system that integrates across Services and functions to provide the Warfighter with a single picture of the battlespace.
- To migrate legacy applications to modern computing principles and technologies through the use of a COE.

To support these goals, the GCCS includes applications that provide efficient monitoring, planning, deployment, employment, and sustainment of military operations from the National Command Authority (NCA) to the Commander, Joint Task Force level.

Army Global Command and Control System (AGCCS)

AGCCS

AGCCS, a seamless C2 system, will be built around the Joint Common Operating Environment (JCOE) and will be an interoperable component of the GCCS. It will be designed to ensure software and technology reuse and minimize duplication among C2 systems. AGCCS is a system development, integration, and maintenance effort initially consolidating three existing projects: Army World Wide Military Command and Control Systems Information System (AWIS), Standard Theater Army Command and Control System (STACCS) and Combat Service Support Control System (CSSCS). AGCCS provides a source of technical support and services in fielding a seamless C2 structure for the Army at echelons above corps.

Army Tactical Command and Control System (ATCCS)

ATCCS

Initially, ATCCS will be linked directly to AGCCS providing the framework of seamless connectivity from brigade to corps. Objectively, the traditional disparate stovepipe functions will merge into a coherent and seamless interoperable program that binds the combined arms BOS together by using the COE. FBCB2 will complete holistic, seamless integration of the tactical battle command by adding capabilities at individual squads and platforms and passing and receiving required data with higher headquarters.

Force XXI Battle Command, Brigade and Below (FBCB2)

FBCB2 provides the lower level interface into ABCS.

Force Level Information Database

The Force XXI Battle Command Brigade and Below (FBCB2) system provides digital connectivity from brigade to the weapon systems/platform level and is comprised of:

- The "applique" -- processing devices connected to navigation devices and radios to provide processing and display capabilities to platforms without an embedded processor.
- Common software, hosted both on appliques and embedded processors, that is interoperable with the C2 systems at brigade and above.
- The "Tactical Internet" -- battlefield communication systems internetted using commercially-based Internet protocols.

The FBCB2 acquisition strategy is phased to support the Force XXI experimental process. During the Concept Exploration Phase, non-developmental prototype equipment will be rapidly acquired

to support the redesign of brigade and below organizations; to evolve new, information based tactics, techniques, and procedures; and to refine digitization requirements. During the combined Demonstration/Validation and Engineering and Manufacturing Development Phase, the acquisition efforts will focus on supporting division and corps level experiments. Software and hardware products will be matured and evaluated to support the decision to enter the production phase. Each phase will be competitively awarded with emphasis on commercial equipment and "best value." Streamlining procedures will be applied throughout.

Force Level Information (FLI) in ABCS

Overall, ABCS provides commanders and staffs with standard, modular, system support and applications support software, coupled with a tailorable set of unique and common functional applications software, to create, access and update a FLI database and generate a user-defined picture of the battlefield, in both time and space.

The key integration feature of ABCS above the operating environment is the establishment of the FLI database, which provides commanders and staffs with the ability to:

- Graphically portray the relevant common picture of the battlefield.
- Project situations, requirements, and capabilities.
- Determine the impact of possible courses of action.
- Develop staff estimates.
- Present findings and conclusions.

The common picture that provides situation awareness for all levels is the sum of all information contained in the FLI database in a graphic display format, defined and tailored by the user according to his needs. The common picture for a division commander differs significantly from that of a battalion commander in terms of time and distance scales and the scope of information tracked, yet each access the same common database. Inputs into the picture include:

- Own, enemy, and friendly locations, to include across boundaries within specified areas.
- Maneuver graphics and control measures portrayed on a digital map display using Army doctrinal scales of 1:50,000, 1:100,000, 1:250,000, and 1:1,000,000.
- Operational, logistical, and personnel status of subunits.
- Digitized terrain data.

In essence, the graphical portrayal of the common picture is very similar to that provided by a state-of-the-art commercial battle simulation, with a zoom-in/zoom-out capability and the ability to access a wealth of information via a series of pull-down menus.

Hardware
ABCS relies heavily on common hardware (CH) to meet future needs and upgrades of current systems at battalion level and above. Platform-specific hardware is developed in keeping with space, configuration, and power constraints of the host air/ground vehicle. Platform hardware consists of embedded or applique sets, as appropriate. Dismounted soldiers use portable systems in general purpose vehicles. The use of smaller hardware at echelons below battalion is desirable in terms of cost and probability.

Common hardware consists primarily of a suite of proven COTS and non-developmental item (NDI) computer hardware. Interfaces to tactical and commercial communications and peripheral devices make up individual workstations, configured into nodes and elements in the C2 architecture via local and wide area networks (LAN/WAN). CH and peripherals incorporate evolving state-of-the-art processing technology to enhance general system performance over time.

Software
Users receive a Common Software (CS) suite appropriate to their hierarchical echelon and Battlefield Functional Area (BFA) consisting of three types of software written to operate with

one another.

- COTS system software and other basic functions, such as database management and word processing.
- COE modules supporting basic system-related transparent operations such as message handling and workstation management.
- Common and unique software modules with common functions, such as movement control and operations plans/orders and unique applications for specific platform and/or BOS functionality.

Provisions also exist to execute applications unique to a specific platform and/or BOS.

Software design incorporates a standard multi-layered open system architecture. Modular functional applications are ported on the COE, interfacing with the COTS system software in a COE, operating on a standard suite of processors.

2.4.3 Force XXI Battle Command Brigade-and-Below (FBCB2) ORD

The FBCB2 ORD further refines the operational capability needs defined in the HIBC MNS and the ABCS-COE/CA ORD. It defines the need for the lowest level C2 interface capability to the ABCS and standardizes the components of that capability. It is being developed by the combat developer (TRADOC) with submission to the Department of the Army targeted in-January 1995 and approval projected by March 1995. The final FBCB2 ORD will evolve through the experimentation process and be refined in coordination with the Air Force and Marine Corps based upon experimentation results. Interoperability certification by the JCS J6 will verify the refinement.

Definition
For the purpose of the ORD, the term "brigade-and-below" encompasses the headquarters and subordinate elements organic to:

- Maneuver brigades (armor and mechanized, light, airborne, or air assault infantry and aviation).
- Armored cavalry regiments (heavy and light).
- Divisional air and ground cavalry/reconnaissance squadrons.
- Aviation battalions (attack, assault, heavy lift).
- Combat Support (CS)/Combat Service Support (CSS) brigade level support units.
- ADA battalions, batteries, platoons, and fire units.

Brigades can be subordinate to a division or operate separately as task forces reporting to a Joint/Combined command authority.

Scope
The FBCB2 ORD establishes the requirements for horizontal and vertical integration of digitized battle command within the Task Force XXI. The ORD looks beyond current interim efforts, such as IVIS and B2C2, toward an objective C2 system for the 21st century. It describes both an integrated C2 system and a future warfighting concept.

The emphasis at brigade-and-below is on situational awareness at all echelons. Information is sent and received digitally in real or near-real time. Information that would take many minutes to obtain is retrieved and displayed in seconds, employing a user-friendly system designed to enhance the capabilities of the individual soldier.

The concept addresses the answers to four basic questions:

- Where am I?
- Where are my soldiers?
- Where is the enemy?
- What is each of them doing?

Functional Requirements
Functional requirements for the platform and squad/section levels are:

- Automatic position location and reporting.
- Digital map with graphics, with a limited color capability (i.e. 8-bit/256 colors) and hasty mapping products.
- Graphical display of the location of radio net members and adjacent friendlies.
- Display enemy locations in predetermined zone or sector.
- Link to the line-of-sight battlefield combat identification system with visual and aural alerts.
- Automated logistics and operational status reports.
- Templates for digital reports and requests, with prompts.
- Information storage and recall.

Platoon Leader and Sergeant
Functional requirements for the platoon leader and platoon sergeant are the same as above, plus ability to:

- Synchronize and control sub-elements.
- Create, send, and receive text and graphics.
- Receive and consolidate status reports.
- Calculate and display platoon center-of-mass (COM) or individual vehicles/squads.
- Display COMs across the battlefield.
- Display COMs of adjacent units outside the company/team radio net.
- Filter out information outside the desired area of interest.

Company Commander, Executive Officer, and First Sergeant
Functional requirements for the company commander executive officer and first sergeant are the same as above, plus ability to:

- Automatically receive, consolidate, and transmit platoon reports.
- Provide an automated roll-up of logistical requirements.
- Display company/team positions by squad/vehicle or platoon COM.
- Display COMs of all elements in battalion task force radio net.
- Display COMs of adjacent units outside the battalion task force radio net.

Battalion Commander, Executive/ Operations Officer, and Command Sergeant Major
Functional requirements for the battalion commander, executive/operations officer and command sergeant major are the same as above, plus ability to:

- Provide access to the ABCS FLI database.
- Provide access to ATCCS to coordinate operations and support.
- Provide a LAN for:
  - C2 Vehicle(C2V).
  - Tactical Operations Center (TOC).
  - Combat and field trains.

Brigade Commander, Executive/ Operations Officer, and Command Sergeant Major
Functional requirements for the brigade commander, executive/operations officer and command sergeant major are the same as above, plus have the ability to:

- Provide access to all available databases.
- directly to both B2C2 (or its equivalent) and ATCCS.

It is important to note the friendly location requirement includes units across adjacent boundaries, in a different combat radio net and possibly belonging to a different parent unit. The urgent need for this information in a near-real-time manner reduces the incidence of fratricide and better coordinates cross-boundary fire and maneuver. It is also a major factor in determining the architectural requirements and procedures to transfer position/location data.

As a subset of ABCS, FBCB2 complies with the ABCS Technical Architecture and COE. This migration to a COE facilitates meeting Joint interoperability requirements. It also is fully functional with other ABCS systems for horizontal and vertical integration. With FBCB2, users can:

- Transmit voice and data from the same platform without mutual interference.
- Use common message formats and protocols.
- Automatically access multiple communications paths.
- Other Requirements of FBCB2
- Operate their systems through user-friendly software and interfaces.
- Acquire and disseminate weather data.
- Operate while on-the-move.
- Employ multi-use application software for use in garrison and in the field.
- Access on line, embedded, or off-line training support packages.
- Fuse digital terrain data and intelligence data into a graphic portrayal of battlespace and situational awareness.

2.5 Other Requirements

2.5.1 Logistics

Supportability
The logistics support strategy for digitization subsystems and components is initially established in accordance with appropriate objectives and policies contained in AR 700-127, Integrated Logistics Support. Early phases rely heavily on contractor logistics support, particularly during experimentation cycles. For systems using appliques, the longer term support strategy depends upon issues such as unit cost, ease of repair, and level of repair. For those systems with embedded digitization subsystems (see section 4.1.1), the logistics are based on the approach applied to the host platform. Generally, supportability and sustainability issues will be addressed by the relevant PEOs/PMs and item managers.

2.5.2 Manpower and Personnel Integration (MANPRINT)

Soldier Considerations
The MANPRINT process focuses on integrating the system with the soldier based on analyses and tradeoffs within and across the seven domains listed below. Implementation of the digitization program will require careful analysis to minimize the overall impact on individual operators, maintainers, supporters, fighting unit, and force as a whole. Although many of the issues are addressed at the platform level by individual PEOs and PMs, tradeoffs addressing force level considerations require particular ADO management and oversight. The character of the issues vary depending upon the implementation at various phases of the program (e.g., applique vs. embedded system). Representative issues associated with the domains include:

- Manpower - Minimizing system manning requirements for operations, maintenance, and support by using automation to reduce manpower spaces for selected functions.
- Personnel - Designing subsystems and components which are compatible with existing military occupational specialty (MOS) skill requirements and personnel capabilities.
- Training - Minimizing the requirement for additional, unique training to operate or maintain digitization subsystems and components; using embedded training and interactive simulation networks to support integrated force training.

- Human Factors Engineering - Optimizing the man-machine interface to maximize effectiveness and minimize harmful effects (e.g., increased workload).
- System Safety - Ensuring that integration of the applique does not compromise the overall safety of the host system (e.g., by affecting ease of egress in an emergency).
- Health Hazards - Ensuring that the integration of the applique does not introduce potential health hazards (e.g., by increasing the potential for electrical shock or physical injury).
- Soldier Survivability - Assessing the contribution of digitization to fratricide reduction through greater situational awareness.

2.5.3 Spectrum Management

Managing the Spectrum
Current and future battlefields present a complex radio frequency (RF) environment. The potential for interference, whether intentional or unintentional, is significant. Such interference degrades the speed, accuracy, and reliability of communications. Even in peacetime operations, limitations on use of the RF spectrum presents a significant challenge. The design of the communications subsystem(s) supporting digitization will have to balance multiple factors such as bandwidth requirements, spectrum availability, compatibility with other communications systems, and susceptibility to jamming.

2.5.4 Security

Information Security
Digitization systems must maintain an appropriate level of security. This will be accomplished by integrating computer and communications security capabilities using technologies currently available and those under development. Additionally, those systems that accomplish data fusion and have Multi-Level Security (MLS) requirements will be met using the technological capabilities of the Multi-Level Information Systems Security Initiative (MISSI) program products as applicable. Other products and services which may come available through market research and technology advances w will be considered in lieu of MISSI components where appropriate. Systems that provide common-view-of-the-battlefield capabilities will be initially secured using Tactical Packet Network (TPN), which is accredited for operations at the Secret level and operates in the Systems High Mode. A migration path will be established to reduce communications accreditation levels to unclassified and encrypt data transmission at appropriate levels from originator to receiver. This path will ensure technology infusion in a timely and cost effective manner. Adequate attention will be given to human resource requirements associated with system security administration.

2.5.5 Survivability

Environmental Factors
Survivability considerations associated with the digitization program cover a broad range of issues. At the lowest level, the ability of the digitization subsystem or component to survive environmental factors (e.g. shock, vibration, temperature, and dust) associated with the host platform must be addressed. This is of particular concern for applique systems consisting of COTS hardware. Means must be found to ruggedize or isolate the subsystem and components from environmental effects.

Electronic Warfare
At a second level, the susceptibility of digitization systems to interception, jamming, deception and exploitation must be addressed. The vulnerability of the information, resident in and accessible through the Internet must be assessed. Information may be lost to corruption by malicious code or the introduction of viruses, as well as the vulnerability of information flow to disruption. The system design must minimize the potential for enemy interference or for exploiting these capabilities against friendly forces.

Finally, the impact of the introduction of digitization subsystems and components on host system

survivability must be addressed. For example, the effect of the addition of digitization capabilities on the RF signature associated with the host system must be assessed. Additionally, the enhancement to mission capabilities should outweigh the costs in terms of increased susceptibility to enemy sensors and weapons.

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Army Digitization Master Plan (ADMP)

CHAPTER 3 - DIGITIZATION IMPLEMENTATION STRATEGY

3.0 DIGITIZATION IMPLEMENTATION STRATEGY

Digitization Goal

The digitization goal is to integrate modern information technology in the Army of the 21st Century (Force XXI). For maximum combat effectiveness, systems must be interoperable among the battlefield operating systems from the individual soldier and platforms to corps. It is, therefore, essential that equipment, common standards, protocols, and naming/addressing schemes enable system-to-system and processor-to-processor linkages across the battlefield.

3.1 Strategic Direction

Decisions of senior Army leaders during the October 1994 Commanders' Conference provide the strategic direction for Force XXI. Information-age technology for battle command, battlespace, depth and simultaneous attack, early entry, and combat service support underwrite our capabilities to project and sustain the force, protect the force, win the information war, conduct precision strikes, and dominate land maneuver across the continuum of military operations in the 21st century.

The leaders in the Army recognize that simply automating existing functions will not yield the full benefits of automation so they have approved a process to redesign the Army. The process of redesigning the operational Army is called Joint Venture. It is led by US Army Training and Doctrine Command (TRADOC) and involves participation of Major Commands (MACOM).

The TRADOC/Joint Venture process redesigns the operating force to be knowledge-based, modular, and tailorable. The ADO supports Joint Venture's efforts by providing information based technologies which will improve the lethality, survivability, and the operating tempo of tactical units.

3.2 Development Through Advanced Warfighting Experiments (AWEs)

Figure 3-1 depicts the process in developing Force XXI. Through an iterative series of modeling, simulations, and Army Warfighting Experiments (AWEs), Joint Venture focuses on providing early digitization capabilities, organizational redesign, new tactics, techniques, and procedures. Two 1994 events, Desert Hammer and Desert Capture III, have become the baseline for two AWEs to be conducted in 1995, Focused Dispatch and Warrior Focus. Focused Dispatch will evaluate the following force enhancements: battalion and brigade organizational changes, digital equipment requirements, training packages for a virtual brigade, fire support enhancements, brigade and below battle command, alternative combat service support structures and operations, Joint and Interagency intelligence connectivity, intelligence collection enhancements, suite of sensors, combat identification solutions, and integration of air defense artillery initiatives. Warrior Focus will evaluate: battle command links from individual soldiers to brigade, special operations forces and conventional mission interfaces, Joint digitization issues, continuous operations, 2nd generation Forward Looking Infrared equipment, training and leader development, weapons of mass destruction defense linkages, advanced precision air delivery system, and enroute battle command.

Figure 3-1 Force XXI Strategy

Preceding each AWE, a sufficient train-up time is provided for participating units to become proficient in the fielded digital capability and refine their tactics, techniques and procedures. This time also allows data collection opportunities for independent agencies to gather empirical data for analysis to determine the value added from insertion of battle command digital technologies. Each experiment is an iterative process to establish a rolling baseline (as described in Annex H, Experimentation Master Plan) by which to compare subsequent experiments.

The critical event in 1997 is the AWE called Brigade Task Force XXI. The major goals of this exercise, which include elements from the US Air Force and the US Marine Corps, are to document improvements in survivability, lethality, and operational tempo resulting from the insertion of digitized technology, and verifying the utility of force structure changes as well as changes in tactics, techniques and procedures. The exercise will also provide insights to division and corps command and control (C2) processes. Once the analysis of Brigade Task Force XXI AWE is completed, it will become the rolling baseline for future exercise comparisons. A division level Battle Command Training Program (BCTP) exercise, called Division XXI AWE, will be conducted in FY98. This exercise will use modeling, simulation, and the Brigade Task Force XXI unit in a live interactive environment. The analysis and lessons learned from Division XXI AWE will then become the rolling baseline for a corps exercise being conducted 2nd Quarter, FY99.

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Army Digitization Master Plan (ADMP)

CHAPTER 4 - DIGITIZATION EXECUTION

4.0 DIGITIZATION EXECUTION

Major Initiatives
In developing the Army Digitization Campaign Plan, four major thrusts were identified. These are: (1) acquiring key hardware and software components using acquisition streamlining; (2) integrating the existing battlefield communication systems into a seamless "Tactical Internet"; (3) employing common data, message formats and, where feasible, common software to assure integration and interoperability across all embedded and Command and Control (C2) systems; and (4) conducting experiments to define near-term augmentations to the "Tactical Internet" and the next generation Battlefield Information Transmission System (BITS). These thrusts, shown in figure 4-1, conducted in accordance with the Technical, Operational, and System Architectures as recommended by the Army Science Board (ASB), and in full compliance with DoD architectural guidance will be executed in a three phase process. The intent is to quickly digitize the battlefield by employing current technologies to acquire, exchange, and process critical information throughout the battlespace and to evolve this capability to reflect both insights gained from Advanced Warfighting Experiments (AWE) and opportunities for technology enhancements.

Figure 4-1 ADO Campaign Plan

The following paragraphs provide detailed explanations about the phased approach, each of the four major Army Digitization Office (ADO) thrusts, the role of the three architectures, and the experimentation and evaluation plan.

4.1 Phased Approach

Program Structure
The Army's digitization effort will be executed in three phases as depicted in figure 4-2 below.

Figure 4-2 Program Structure

Phases 1 and 2 support the Army's efforts to infuse information technologies, refine tactics, techniques, and procedures and to assist in the design of the 21st century Army. Phase 3 will produce hardware and software to equip additional Force XXI units.

4.1.1 Phase 1. Brigade Task Force XXI -- Concept Exploration

This phase began with Army approval of the Horizontal Integration of Battle Command Mission Need Statement (HIBC MNS) in October 1994 and continues through the conclusion of Brigade Task Force XXI, the Army's first major AWE employing a wide range of information technologies. The FY 95 AWEs together with the Brigade Task Force XXI experiment, consisting of nine months of intensive training on the use and employment of information technologies and culminating in a force-on-force exercise at the National Training Center (NTC), will evolve Doctrine, Training, Leader Development, Organization, Materiel, and Soldiers (DTLOMS) for a

brigade size task force.

The Force XXI Battle Command Brigade and Below (FBCB2) contract, competitively awarded in January 1995, will provide hardware -- termed the applique -- software, platform integration as well as logistics support and training support. Ongoing contractual vehicles will be used to product improve the communications systems and acquire the routers that will provide seamless interoperability.

4.1.2 Phase 2. Division and Corps XXI -- Demonstration/Validation, Engineering and Manufacturing Development

This phase begins with a milestone I/II review conducted at the conclusion of the Brigade Task Force XXI AWE and continues through the conduct of the corps level AWE called Corps Task Force XXI. During this phase the focus will change from brigade and below to division and corps level. Software and hardware products will be sufficiently mature to provide the exercise unit with a contractor supported go-to-war capability. Training and support products will be developed in preparation for a Deployment decision in FY 99.

The basic Corps Task Force XXI contract will be competitively awarded in FY98. The scope of the Corps Task Force XXI contract will be similar to the previous FBCB2 contract. The winning contractor will have overall system responsibility, make software updates, and provide logistics support. The contractor will also provide hardware to equip two division headquarters and a corps headquarters, needed to support the Corps Task Force XXI experiment.

The Corps Task Force XXI contract will contain an option to procure two additional sets of brigade hardware. At the conclusion of Corps Task Force XXI, one division; two additional division headquarters; and one corps headquarters will be equipped with modern information technologies, assuming that ADO Program Objective Memorandum (POM) 97 funding requirements are supported.

Also during this phase, the Army will augment the "Tactical Internet" by incorporating the Near Term Data Radio. This radio will provide improved capacity and will serve as the data transmission backbone for brigade and below.

4.1.3 Phase 3. Force XXI --Deployment

A Milestone IIIA review will be conducted following the Corps Task Force XXI AWE. This milestone will trigger the Deployment phase award for a full corps set of equipment. The Deployment phase contract will be competitively awarded and will contain several options, structured to meet the normal 12 month funded delivery periods.

During this phase, the Army will transition to the next generation "Tactical Internet", termed the BITS.

4.1.4 Resources

The current funding profile, shown in figure 4-2, is expected to provide fiscal resources to support the initial phases of the digitization effort. Additional hardware and software requirements are expected to emerge during the experimentation process. As these additional needs are validated, the funding profile will be adjusted accordingly. Digitization resources which exist in other programs are not included in this funding profile.

4.1.5 Execution Strategy

4.1.5.1 Evolutionary Acquisition

An evolutionary strategy will be used to develop FBCB2 software. Users will be involved with the

software development from the beginning of the program. Each US Army Training and Doctrine Command (TRADOC) Battle Lab, various TRADOC Directorates of Combat Developments, Program Executive Offices, and Army Materiel Command (AMC) Research, Development, and Engineering Centers (Reds) will be connected through the Army Interoperability Network (AIN) to the FBCB2 contractor's development facility. User "juries" will help the developers to design the most effective interface designs. As the FBCB2 software functions mature, the AIN will also permit users to remotely operate with other battlefield operating systems (BOS) using the Digital Integrated Laboratory (DIL) of the AMC Communications and Electronics Command (CECOM). The DIL is a collection of real and simulated command, control, and communications (C3) facilities that, when connected to the FBCB2 system, will assist TRADOC in the development of tactics, training, and procedures. Frequent software releases will also aid in keeping user interest and evolving them in the requirements process.

4.1.5.2 Standards Based Implementation

Both the information processing and information transport components will utilize widely-used open system standards and layered architectures as prescribed in the Command, Control, Communications, Computers and Intelligence (C4I) Technical Information Architecture. Open systems are characterized by their use of standards to define services, interfaces, and formats. Implementing well defined, widely known, and consensus based standards allows the Army to leverage the commercial marketplace's investments and to promote the development of both interoperable and integrated systems.

All Army systems will be required to comply with the standards-based architecture. The Army Acquisition Executive (AAE) is the Army's Technical Architect responsible for codifying and maintaining the Army Technical Architecture, ensuring that all Army information systems are developed in compliance with the Technical Architecture, interfacing with DOD and other Service C4I architecture/interoperability offices, and ensuring that the mandated Technical Architecture is included in procurements. The DIL will validate system compliance with prescribed standards and protocols. It will also certify interoperability between systems as a prerequisite to participation in AWEs and fielding to a tactical unit.

4.1.5.3 Embedded Platforms

The use of appliques is intended to provide C2 capabilities to platforms that either have no embedded C2 capability or whose existing capability, in terms of computer processing power, displays, etc., is inadequate to meet emerging user requirements. The applique will continue to be the materiel solution for those platforms, such as the High Mobility Multipurpose Wheeled Vehicle (HMMWV), which are not planned to be upgraded with an embedded capability. For other platforms, such as the Abrams tank and the Bradley Fighting Vehicle, digitization related modifications will be included in the larger product improvement programs. These product improvement programs will encompass necessary software modifications to comply with the Technical Architecture and use common software modules. This may also require hardware modifications including processor, memory, storage and displays. While these programs will continue to be managed by the affected program manager, the ADO will insure that product improvement programs incorporate the Army's Technical Information Architecture and are designed to achieve the required degree of interoperability.

4.1.5.4 Other Interfacing Systems

Systems running the FBCB2 software will have to interoperate with other information systems on the battlefield and potentially in garrison. Common data elements and message structures and, where appropriate, common software modules, consistent with the Technical Architecture, will be mandated to ensure seamless interoperability. Common data elements will be defined consistent with the DOD C2 Core Data Model process. A preliminary set of message structures has been developed and submitted for Joint accreditation and use.

4.1.5.5 Communications Systems

The initial digitization effort relies on communication systems that are currently being fielded. Existing contracts to improve the SINCGARS, EPLRS, and the Mobile Subscriber Equipment (MSE) system must continue as planned to enhance the capabilities of the individual communication systems and acquire the routers to interconnect these systems into the "Tactical Internet". These systems will remain under the management control of the PEO for Communications (COMM) and the individual program managers (PMs).

Future communication systems may augment and eventually replace components of the "Tactical Internet"; however, they will be required to internetwork with the communication systems defined as part of the Army's architecture. Satellite communications (SATCOM), both military and commercial, are providing higher bandwidth beyond line-of-sight capabilities to link diverse units across the digital battlefield and from Continental United States (CONUS) to force projection battlefield locations. Commercial systems offer significant capacity at lower cost while military SATCOMs provide secure capability which can operate under battlefield conditions. Emerging direct broadcast satellite capabilities will make tailored, relevant, and timely data available to warfighters at all echelons.

4.1.5.6. System Integration

During each phase of the digitization program, a prime contractor will have overall system responsibility, but will not have total execution responsibility. In order to horizontally and vertically link weapons, sensors, and C2 systems, many existing and future contracts must be modified. The prime contractor will be responsible for coordinating interfaces with other primes and assisting the system engineer for Technical Architecture in configuration control and maintenance of Technical and System Architectures.

4.1.5.7 Non-Developmental Items

The use of non-developmental hardware and software is a major component of the initial digitization acquisition strategy. Emphasis is placed on maximizing the use of COTS hardware and determining the degree of required ruggedization. There are substantial cost differences between commercial and ruggedized computers. Even greater differences exist between commercial and nearly militarized computers. The intent of the experiments is to determine whether commercial computers can be adapted to operate in tactical environments.

Non-Developmental Item (NDI) software, whether COTS or government furnished, will be used extensively. The FBCB2 contractor has been given two existing, government owned software application programs (IVIS and B2C2) which collectively provide most of the initial functions needed to support the Brigade Task Force XXI experiment. It is intended that the software modules developed by the FBCB2 contractor will be provided for use by other Army information system program efforts.

4.1.5.8 Acquisition Streamlining

The ADO has been charged by the Army Acquisition Executive (AAE) with developing and implementing acquisition streamlining concepts to support the Force XXI objectives. One of the primary goals of Force XXI is to redesign the operational Army based on the widespread use of information technologies. The Army is establishing a standards based Technical Information Architecture. The Technical Architecture will adhere to many commercial standards and protocols. However, contractors will be required to use specific standards adopted by the Army to insure interoperability between systems.

4.2 Major Thrusts

4.2.1 Thrust 1 - Acquisition

The ADO's acquisition plan for providing digital capability to Force XXI units is called the Force XXI Battle Command, Brigade and Below (FBCB2) effort. The ADO will coordinate and integrate the FBCB2 effort with the PEO for C2 Systems. The FBCB2 contractor will develop the platform integration package, with training and logistics functions. In the future, these functions will become part of the normal training and logistics processes used for all systems.

To maximize the advantages of information technology across the force, participants must be equipped with digital systems. Since very few systems at brigade and below possess a digital capability now, the capability must be added as an "applique".

Applique Systems
For a platform that has no capability now, the applique will consist of a Global Positioning System (GPS) receiver, a computer unit (commercial, ruggedized or militarized), and an interface to the Single Channel Ground and Airborne Radio System (SINCGARS), and/or Enhanced Position Location Reporting System (EPLRS) radio. A common "core" application software capability will reside in all appliques, regardless of platform. Additional software modules will provide the interface with embedded systems on the M1A2 tank, AH-64, and OH-58D aircraft. Selected platforms from the Marine Corps and the Air Force will also require appliques to participate in the experiments.

The initial set of appliques will be used primarily for situational awareness and operational control. The exact applique is system dependent, based on the user's need, and varies in ruggedness from commercial through militarized items. Applique solutions are not practical on all platforms. On those where space, weight, power, electrical interference, or human interface restrictions are encountered, or where the applique may restrict mission capability, other solutions must be identified. Three options exist for appliques:

- Commercial Off The Shelf (COTS): The installation kit provides shock and some environmental protection. The COTS approach permits replacement of processing and display capability relatively inexpensively.

- Ruggedized: Shock and environmental protection, equivalent to that used for industrial applications, is external to the COTS equipment. Future upgrades may be accomplished on selected components.

- Militarized Items: Shock and environmental protection is integrated into the computer. The installation kit provides mount and platform integration.

In addition to the applique hardware, common application and support software will be provided. The software will contain, as a minimum, the functionality provided by the C2 portion of the InterVehicular Information System (IVIS) found in the M1A2 tank and the Brigade and Below Command and Control (B2C2) prototype software. The software developed will meet open system standards and be non-proprietary except under the most compelling circumstances. The software will be forward compatible with the main stream of commercial hardware and software developments to allow ease of new technology insertion. The applique contractor will be encouraged to reuse and incorporate existing government and commercial software.

The contractor will have overall system responsibility. Contract tasks include:

- Developing FBCB2 software.

- Acquisition of four types of computer processors (appliques) that include commercial, ruggedized, and nearly militarized platform-mounted configurations as well as a hand-held configuration for use by dismounted forces.

- Designing and producing installation kits needed to mount the computers on representative

samples of Army, Marine Corps, and Air Force major weapon systems and C2 platforms.

- Providing contract logistics support for FBCB2 hardware and software.
- Creating interface documents along with recommended engineering changes needed to install either an applique or the FBCB2 software in embedded weapon systems.
- Providing the means to technically manage the "Tactical Internet" communication infrastructure.

The basic contract provides software, hardware, and systems support to equip most of a modernized brigade organization along with its associated divisional support elements, such as artillery and engineer support, as well as accommodate data inputs from the corps level.

The FBCB2 contract will contain one option to procure additional hardware, make software changes, and provide systems support needed to conduct the Division Task Force XXI AWE. The precise scope of the option award will be based primarily on feedback obtained from data taken during the Brigade Task Force XXI training period. The hardware will be sufficient to complete the fielding of the modernized brigade, to fully equip the division headquarters, and to equip only those corps level units needed to fully exercise command, control, and intelligence inputs to the division headquarters.

4.2.2 Thrust 2 - "Tactical Internet"

Figure 4-3 Tactical Internet

Seamless Connectivity
Reliable, seamless communications connectivity is required to support the applique, other C2 systems and embedded systems. The initial digital system consists of space based assets, the EPLRS, the SINCGARS, and the Mobile Subscriber Equipment/Tactical Packet Network (MSE/TPN). These digital transport capabilities are key to moving information among the platforms and C2 nodes. The goal is to achieve seamless information transfer horizontally and vertically on the battlefield.

Gateways Provide Seamless Connectivity
The term "Internet" is appropriate because of the functional similarities to the commercial Internet and because actual Internet technology is being used. When sending messages, "Tactical Internet" users will only have to concern themselves with message addresses just as commercial Internet users have to address electronic mail. Commercial Internet technology such as routers and gateways, and protocols such as Transport Control Protocol (TCP) and the Internet Protocol (IP) are the key to providing seamless connectivity between the existing tactical communications systems. Unlike the commercial Internet, the "Tactical Internet" will be operated as a SECRET high system. All directly connected host computers will be capable of operating up to the SECRET level and therefore direct connections to the UNCLASSIFIED commercial Internet cannot be permitted. There is, however, great interest in the new end-to-end encryption devices that will permit UNCLASSIFIED users to use the SECRET high "Tactical Internet" to access UNCLASSIFIED computers connected to the commercial Internet. This capability is being pursued particularly for the Combat Service Support users who typically operate UNCLASSIFIED applications, and need to communicate in a split based mode with large computers in the CONUS.

Improved versions of the three primary Army tactical communications systems—EPLRS, SINCGARS, and MSE/TPN—will all be needed to move the ever increasing amount of digital data required on the modern battlefield. Capabilities will also exist to interface commercial and military SATCOM to the "Tactical Internet" which will provide unprecedented capacity and access to very low echelon units. In the near-term, the three terrestrial communication systems will be combined through commercial Internet routers to form a complete, seamless system that

will provide the tactical equivalent of the Internet architecture for the initial brigade-sized task force and division digitization experiments. Tactical Multinet Gateways (TMGs), which are off-the-shelf commercial routers, and Internet Controllers (INCs), which are single circuit card, militarized Internet routers incorporated in the SINCGARS mount, provide the ability to send messages automatically between the tactical networks.

SINCGARS improvements include reduced co-site interference, improved error correction and net access delay, and an interface to Global Positioning System devices to obtain accurate time of day and position location. Collectively, these improvements will greatly increase data communication ranges and increase the throughput from 1.2kbs to 4.8kbs. Initial Electronic Proving Ground test results indicate that SINCGARS will be able to reliability pass data at 4.8kbs at ranges up to 35 kilometers in a benign environment.

The EPLRS system is incorporating Very High Speed Integrated Circuit technology which will increase the throughput of individual radios from 4kbs to 12kbs. Produceability improvements are also being made which will reduce unit production cost and ensure the continued availability of repair parts for the existing systems. Finally, the Network Control Station functions, which are currently performed by a dedicated set of HMMWV mounted equipment, are being redesigned to operate on a single computer that will be collocated with the Integrated System Controller (ISYSCON) facility. The NCS downsizing program is a Joint USA EPLRS-USMC Position Location Reporting System (PLRS) initiative.

The MSE/TPN program is upgrading routing protocols from Exterior Gateway Protocol (EGP) to Border Gateway Protocol (BGP). This change will substantially reduce the bandwidth required to exchange routing information between routing devices in different networks.

Improvements to each of these systems are needed to make the "Tactical Internet" viable. While the use of commercial Internet protocols provide the much sought after seamless connectivity between the different networks, seamlessness does not come for free. Internet protocols increase data capacity requirements since additional header information is added to each message. The Internet routers exchange routing and status information which also increase data capacity requirements. Even with the improved data capacity of SINCGARS, EPLRS, and MSE, these systems provide relatively small communications trunks compared to commercial, fixed locations. As a result, a comprehensive modeling and simulation effort is also required to determine the optimum parameters for the use of Internet protocols in a dynamic military environment which has relatively limited communication links.

Another key component of the "Tactical Internet" is the ISYSCON program. Currently the ISYSCON program is developing the capability to technically control networks at brigade and above. Since Tactical Multinet Gateways and Internet Controllers must also be technically controlled, additional ISYSCON capabilities are being added to control the "Tactical Internet" at brigade and below.

The Signal Center, in conjunction with AMC (CECOM), is investigating the operational and training impact of the "Tactical Internet". A series of battle lab experiments, Joint Chiefs of Staff sponsored Joint Warfighting Interoperability Demonstrations (JWIDs), and AWEs will provide the experimental basis to determine if additional personnel are needed, to determine training and skill levels, and to recommend changes to communications tactics and procedures.

PEO COMM, with the support of AMC (CECOM) and the Signal Center, is responsible for developing the "Tactical Internet" in accordance with the Army's Technical Architecture. The improvements to the radios, ISYSCON, and the modeling and simulation will all be completed by May 1996.

4.2.3 Thrust 3 - Integration of Battlefield Operating Systems

Integration of new or evolving digitization technology presents many challenges in

synchronization of diverse acquisition and development program products as well as achieving the technical integration of these products into the overall system of systems supporting the digitized force. The integration effort will successfully tie all of the components of the ABCS into a seamless network from the soldier through the tactical and operational levels to the sustaining and strategic level.

The ADO, in conjunction with representatives from the PEOs, Department of the Army, Deputy Chief of Staff for Operations and Plans (DA DCSOPS), AMC, and Secretary of the Army Research, Development, and Acquisition (SARDA), will integrate the acquisition and technology development programs. PEO CCS has been designated by the ADO as the responsible agent to ensure technical integration of all the systems within the digitized force. PEO CCS' contractor will be responsible for the technical systems integration of FBCB2 hardware and software across the entire combined arms team. In support of this requirement the FBCB2 contractor has a task to perform systems engineering, integration, and qualification to support implementation of the FBCB2 software into platforms with existing embedded systems (e.g., M1A2 systems enhancement program). Under the guidance of PEO CCS, he will work closely with PMs whose weapons platforms will be fitted with appliques and/or FBCB2 software. He will identify necessary upgrades in weapons system computing platforms and provide system engineering services to PMs as necessary. The ADO will coordinate the efforts between the software developers and the platform developers, and will assist platform developers in demonstrating system interoperability prior to fielding.

4.2.3.1 Embedded Systems

Embedded systems are platforms with digital system components providing functions and processes which are integrated to such an extent that they can not be considered as discrete entities during development, testing, or production of a system. Such systems can include fire control, position/navigation, diagnostics and communications equipment found on the M1A2 Abrams, Apache Longbow, and OH-58D Kiowa Warrior weapon systems. The software and hardware of these platforms may also perform common battle command functions such as situation awareness, use common digital terrain data and receive/transmit digital messages.

Some embedded digital systems are wholly contained within a platform type and their standards and protocols for internal connectivity are defined within the purview of the PEO. The PEO must consider cost while effectively applying standard development concepts such as growth, open system architectures, flexibility, and interoperability with other platforms.

Modular, multi-function hardware designs will be adopted. Emerging technology affords the opportunity for a significant shift away from single-purpose designs to multi-purpose implementations where functions are implemented on removable, upgradable circuit cards, microchips, or in the software.

Embedded digital systems that interact with other dissimilar weapon systems or C2 nodes must, as a minimum, use common message sets. Digital communications, standard data protocols, icons, and applications are required to pass the "same information" for applications such as overlays, calls for fire, and spot reports. These requirements will be documented in Interface Control Documents (ICD).

The embedded digital systems already in use or planned to be fielded in the battlefield functional areas are part of the digital System Architecture. This System Architecture will include interoperability with the embedded command and control systems. The challenge of integration remains at the lower levels, where existing legacy systems have been developed to provide vertical "stovepipe" information flows for specific battlefield functional areas. As such, the FBCB2 contractor has a task to develop System/Subsystem Segment Interface Control Documents (ICDs) for the approximately 28 platforms (e.g., M1A1, M2A2, M113, HMMWV) to be digitized. The ICDs will document interfaces to existing platform power, MIL-STD 1553 data bus, communications, navigation, and sensor sub-systems as appropriate. The ADO is developing a

series of MOAs with all the PEOs which develop platforms with embedded systems. The MOAs require the PEOs and PMs to ensure their systems are compliant and interoperable with the Army's Technical Architecture and common operating environment (COE). They will continue to be responsible for automated platform management functions. Platform PMs will be required to:

- Provide support to the FBCB2 Program Manager which will include providing technical data packages to the applique prime contractor for development of installation kits and interfaces; providing technical assistance in evolving/defining system integration requirements; and making platforms available for technical integration testing.
- Develop migration plans that lay out a strategy for migrating their systems to the evolving Technical Architecture to include MIL-STD-188/220(), Variable Message Format (VMF), the Command and Control Core Data Model and the COE.
- Integrate the FBCB2 software supplied by the PEO CCS as an additional application or task to share the host processor with existing weapon system specific applications.
- Develop and document in the program acquisition strategy the program funding and schedule changes to support migration to the digitized force. Incorporate digitization test criteria in the system Test and Evaluation Master Plan.
- Address the critical elements of the digitization initiative in all program reviews.

4.2.3.2 Non-Embedded Legacy Systems

There are numerous non-embedded legacy systems currently fielded that will be a part of the digital battlefield. These systems present a wide range of integration issues associated with protocols, data standards and message exchange. For example:

- ATCCS currently utilizes the United States Message Text Format (USMTF) as its primary message exchange system.
- The Interim Fire Support Automated System (IFSAS) and TACFIRE use the TACFIRE protocol and message set.
- The Marine Corps Tactical Command and Operations (TCO) System employs the Marine Tactical System protocol and message set.

To reduce the risk associated with the development of FBCB2 software and the "Tactical Internet", backward compatibility will be selectively implemented. The FBCB2 software and "Tactical Internet" will be baselined on the MIL-STD 188-220 () and the Task Force XXI VMF Technical Interface Design Plan (TIDP) which have been submitted for Joint approval, as well as, the DOD adopted TCP/IP and Internet Protocols.

The ADO will work with various legacy PEOs and PMs to obtain forward compatibility with FBCB2 software and the "Tactical Internet". For example:

- PEO CCS will develop a USMTF to VMF translator to achieve interoperability as ATCCS migrates to the Joint VMF.
- PM AFATDS will implement the Task Force XXI VMF fire support messages on a timeline consistent with the FBCB2 software effort.
- PEO COMM will implement MIL-STD 188-220 () and DOD adopted TCP/IP and Internet Protocols in the SINCGARS SIP program.

In those cases where schedule, funding or technical considerations do not allow integration and

interoperability in the near-term; SINCGARS SIP, applique hardware, and FBCB2 software maybe provided as an interim capability.

4.2.3.3 System Engineering Process

The digitization effort requires change to almost every platform or automated system in the Army. The Army Acquisition Executive has directed that a Systems Engineering Office be established to ensure that all systems which will be part of the digitized force conform to the standards established in the Technical Architecture and are interoperable with the other elements of the System Architecture. The System Integrator will implement the System Architecture.

4.2.3.3.1 Certification of Compliance with the Technical Architecture

One of the responsibilities of the System Engineer is to ensure that all systems and system elements which are part of the digitized system comply with the Technical Architecture and other standards as directed. The System Engineer and his staff will review all developmental and fielded systems for compliance with implementation of the COE, the C2 Core Data Model, use of Ada, Human Computer Interface standards, MIL STD 188/220 (), and VMFs. The Systems Engineer will also ensure that any prototype, developmental, and fielded system which will be connected to the digital force is interoperable and has adequately considered the C2 Protect/Vulnerability issues for that system.

4.2.3.3.2 Digital Integration Laboratory (DIL)

To the maximum extent possible, new hardware and software will be developed centrally and provided to PMs or ATD/ACTD managers for incorporation into their products. In other instances, programs and products may develop hardware and software with equivalent functionality. In all cases, these systems must be interoperable.

Recognizing the need to certify system and system element interoperability, the Force XXI Board of Directors directed establishment of a DIL. The DIL, located at and operated by CECOM, is the focal point for many other Army agencies which have a role in interoperability testing and certification.

The DIL is one of the primary tools supporting the System Engineer, System Integrator, and system integration contractor in the development of FBCB2 battle command software. The PEOs uses the DIL to connect to the TRADOC Battle Labs for early software prototyping and experimentation. This networked prototyping environment will facilitate getting quick turn around evaluation of software functionality and soldier-machine interfaces by software user juries.

The DIL will also coordinate efforts to integrate other AMC interoperability labs and Battle Labs to provide a virtual brigade capability. The operational test community requires this capability to support the "rolling baseline" evaluation of FBCB2.

4.2.4 Thrust 4 - Battlefield Information Transmission System

Push to Accelerate Improved Digital Capabilities
While the "Tactical Internet" described in Thrust 2 will substantially improve communications connectivity, the digital data load of the future is expected to exceed the capacity of the "Tactical Internet". BITS, as illustrated, is an umbrella concept that is intended to capitalize on the use of emerging commercial systems, such as direct broadcast satellites and digital cellular telephones, and commercial component technologies such as Digital Signal Processing (DSP) chips and Monolithic Microwave Integrated Circuits (MMIC) in military unique systems. DSP and MMIC components are particularly attractive because of their ability to substantially improve performance and to reduce size, weight, power, and unit cost.

Figure 4-4 BITS Umbrella Concept

The BITS acquisition strategy has near and far term paths. The Army has an immediate need to acquire more data radios to support Brigade and Below communications. The EPLRS will be used during the brigade level Task Force XXI Army Warfighting Exercise.

Figure 4-5 BITS Acquisition Strategy

However, there are insufficient EPLRS radios to support the Division and Corps level exercises. Since EPLRS technology was developed in the mid-80s and has a relatively high unit cost, the Army will solicit industry for a Near Term Digital Radio (NTDR) that offers the potential for increased performance significantly below the cost of EPLRS. PEO Communications is preparing a performance based specification which maximizes the use of commercial parts, specifications, software, and standards that will be released to industry 3rd Quarter FY 95. A contract for 400 NTDR radios with an option for up to 700 more will be competitively awarded 1st Quarter FY 96 assuming that industry can respond to the Army's performance and schedule requirements. If the NTDR program cannot meet the Division XXI AWE schedule and quantity requirements, the Army will be prepared to award a contract for up to 400 additional EPLRS. At the conclusion of the Division and Corps Task Force XXI AWEs, the Army plans to procure up to 5,000 NTDRs to equip the highest priority (Force Package I) Army units.

The far term BITS strategy is currently being developed by the Directorate of Information Systems for Command, Control, Communications and Computers (DISC4) and will be completed in March 95. The far term strategy will provide a management framework and long term focus for the large number of ARPA projects, Army Advanced Technology Demonstration (ATDs) projects, and Battle Lab Warfighting Experiments (BLWEs) that are addressing future communications needs. The far term strategy will use an experimental process to assess military utility, cost effectiveness, and requirements documents based on the needs to participate in Major Regional Conflicts and Operations Other Than War (OOTW)

4.3 Architectures

Architectures Support Interoperability
To achieve the vision and goals of Force XXI, all battle command systems must be flexible and interoperable. The supporting battle command information infrastructure must support the ability to structure a force rapidly and efficiently to meet any future contingency. Furthermore, given the requirement for a force projection Army, and the requirement for split-based operations, interoperability and flexibility are necessary among tactical systems; post, camp, and station information systems; and Standard Army Management Information Systems (STAMIS). Moreover, the need for interoperability and interconnectivity of battle-command systems is not just an intra-Army issue. The need to conduct Joint and Coalition operations requires open, flexible, and interoperable information infrastructures and the ability to facilitate training in a synthetic theater of war (STOW).

In 1994, the ASB presented the results of its Summer Study on a Technical (Information) Architecture for command, control, communications, computers, and intelligence (C4I). In their final briefing, the ASB defined Technical Architecture, differentiated it from Operational and System Architectures and recommended a process and an organizational structure for developing and enforcing an Army-wide Technical Architecture. The Army has implemented the ASB's recommendations and has put in place a mechanism for developing all three architectures.

4.3.1 Operational Architecture

As defined by the ASB and accepted by the Army, an Operational Architecture defines what is to be built. It describes who needs to exchange information, what information needs to be exchanged, and how that information will be used. The Operational Architecture is being developed by TRADOC with technical support from PEO CCS.

The architecture will describe the functions, processes and data required to digitize the battlefield, using the Integrated Computer Aided Manufacturing (ICAM) Definition (IDEF) method IDEF0 process model and IDEF1X data model. Since the "Tactical Internet" allows communications to be dynamically routed, a logical connective diagram will also be developed to graphically portray required connectivity between force elements: operations facility to operations facility, operations facility to weapon systems, sensors to operations facility/shooters, and the like. The description also includes the types and frequency of the information sent between those elements as well as performance bounds (e.g. speed of service required). The architecture will require a detailed breakout of functions, processes and information flow and will be developed over an extended period of time as an evolutionary process. The initial focus will be on developing the Brigade and Below portion of the battlefield to include Joint information exchange requirements. Identification of the force elements to be a part of the digital battlefield completes the Operational Architecture.

4.3.2 System Architecture

The System Architecture shows the specific hardware needed to provide the connectivity required in the Operational Architecture. Both architectures are very closely linked. The System Architecture is a description of the physical connectivity of an information system, which includes: identification of all equipment (radios, switches, terminals, computers, inter-networking devices, and local area nets (LANs) and their physical deployment; the specification of such parameters as the bandwidth required on each circuit; and the description, including graphics, of technical characteristics and interconnection of all parts of an information system. The System Architecture process entails trade-off analyses to optimize overall network and system performance within the performance bounds defined in the Operational Architecture.

4.3.3 Technical Architecture

The Technical Architecture is defined as a minimal set of rules governing the arrangement, interaction, and interdependence of the parts of an information system. The purpose of the Technical Architecture is to ensure that a conformant system satisfies a specified set of requirements. The Technical Architecture is analogous to the building code for homes. It does not say what to build (that is defined by the user in the Operational Architecture), nor does it say how to build (that is defined by the developer/integrator in the System Architecture); but it does say that when you build you must adhere to the set of rules/standards that it specifies-the standards the "building inspector" enforces.

The standards laid out in the Technical Architecture establish the framework for achieving interoperability and commonality among component hardware/software and seamless connectivity between communications on the digital battlefield. Standards facilitate less costly component upgrades through technology insertion. An open systems architecture is being adopted that is compliant with DOD standards and which makes maximum practical use of commercial standards, consistent with mission requirements. Where commercial standards prove inadequate, efforts will be initiated to incorporate required military features into the system and if possible into the commercial standards. While all Army information systems will be required to comply with the Technical Architecture, specific migration schedules will have to take into account planned system upgrade windows.

The Army Technical Architecture consists of four elements: (1) the information processing profile; (2) the information transport profile; (3) information standards; and (4) human-computer interface.

Figure 4-6 Technical Architecture

4.3.3.1 Information Processing Profile

The Information Processing Profile defines a detailed suite of commercial and government standards and associated implementation profiles consistent with the TAFIM Technical Reference

Model and standards profile. Compliance with a standard information-processing profile promotes the development of integrated applications, that is, applications that share functions and data.

Common Operating Environment
The COE is the set of integrated support services that support the mission application software requirements. In addition, it provides a corresponding software development environment, architecture principles, and methodology, which assists in the development of mission application software by capitalizing on the infrastructure support services.

Efforts are underway to define and evolve a COE, both within the Army and in the Joint GCCS. The Army is committed to using the COE not only for echelons above corps (EAC) C2 systems but also for tactical C2 systems. Where necessary, the Army will extend the JCOE to fulfill support requirements for battlefield C2 systems. The Army will provide those COE extensions to other Services and GCCS, as requested.

The requirement for a COE is documented in the draft ABCS Common Operating Environment/Common Applications (COE/CA) ORD. This ORD requires the migration of the separate Army C2 Systems into one integrated system. Functional area applications will be ported to a COE with common data elements and structure to provide assured horizontal and vertical interoperability and decreased design and training costs.

Figure 4-7 Mid Term (FY96) Common Operating Environment

One of the fundamental concepts of the COE is that shared services will be available to other applications through program level interfaces. These shared services comprise the COE. These interfaces will be designed and documented so they are easy for other developers to understand and use. The agreement is that these APIs will be baselined and not subject to change unless agreed t o by the affected parties through a formal configuration management procedure.

4.3.3.2 Information Transport Profile

Information Transport Profile
The information transport profile defines the communications support required to provide seamless, reliable, and timely data exchange between users, regardless of the specific communication system(s) that they access. Communications systems and related network interfaces define the topology of the system; common protocols provide the "glue" necessary for seamless data exchange between users. A communications system conformant to the Open System Interconnection (OSI) Reference Model includes services of all appropriate layers plus the physical transmission media and the support and mission-area applications. These services may be grouped into functional levels that represent major capabilities, such as switching and routing, data transfer, and applications support.

Figure 4-8 OSI Reference Model

The Model for Open System Interconnection is explained below. It groups the functions and protocols necessary to establish and conduct communications between two or more computer systems into seven layers.

- The Transmission Level (below the OSI layer 1) provides all of the physical and electronic capabilities that establish a transmission path between functional system elements (wires, leased circuits, and interconnects).
- The Network Switching Level (OSI layers 1 through 3) establishes connectivity through the network elements to support the routing and control of traffic (switches, controllers, network software, etc).
- The Data Exchange Level (OSI layers 4 through 7) accomplishes the transfer of information

after the network has been established (end-to-end, user-to-user transfer) involving more-capable processing elements (hosts, workstations, servers, etc).

- The Applications Program Level (above the OSI) includes the support and mission area "non-management" application programs.

The common thread in moving to a single network will be the use of DOD and de facto Internet protocols, specifically TCP/UDP and IP at layers 4 and 3b, respectively. At the lower layers (1-3a), unique protocols will continue to exist to accommodate each of the several communication systems. Most notable is MIL-STD 188-220 (), which is used with Combat Net Radio and is currently under revision.

4.3.3.3 Information Standards

Information standards, encompassing standard data elements and message standards, provide the basis for information sharing across boundaries. Without such standards, it is necessary to build and maintain individual interfaces, not only a costly proposition but one which often results in inconsistent and unreliable data received from multiple sources.

The ASB has recommended a model-based approach to data standardization which consists of:

- An activity model that shows the relationship between an activity and the information that it uses or produces. The Integrated Computer Aided Manufacturing (ICAM) and the Integrated Definition Model (IDEF0), provide standardized procedures and diagramming conventions consisting of: (1) node trees which graphically portray activities hierarchically; (2) context diagrams which show the highest level activity and its inputs, controls, outputs, and mechanisms; and (3) decomposition diagrams, which show lower-level activities and their information relationships. Documenting requirements such as operational requirements analyses and associated user functional descriptions in the IDEF0 conventions will provide a common way to depict the processes and information requirements within and between functional areas. Efforts have been initiated to depict the information flows identified in the brigade and below Operational Requirements Analysis in IDEF0 conventions.

- A data mode, building on the activity model, defines entities, their attributes, and their relationships. IDEF1X, a methodology created to help design data, provides a structured notation and syntax consisting of: (1) a set of diagrams containing entities, their attributes, and their relationships; (2) a glossary which defines the entities and attributes; and (3) business statements, which are detailed, written descriptions of the way in which data relate to other data. The C2 Core Data Model uses IDEF1X notation and modeling conventions to describe the core data required across all C2 sub-functional areas and presents a common approach to describing tactical C2 information. It consists of 165 entities and more than 800 attributes. These attributes, together with their definitions and associated metadata (data describing data elements), will form the basis for submission of candidate standard data elements to the DOD data standardization program. The C2 Core Data Model is the foundation for the development of standard data elements and, as necessary, will be extended to reflect data requirements specific to battlefield digitization.

- Technical, procedural, and methodological conventions used to establish standard data elements, including metadata and modeling products as documented in DOD 8320.1 series guidance (Standard Data Elements for Automated Information Systems (AIS) Design and Development).

- Data dictionary or other repository for standard data elements.

The VMF provides a common standard for formatting bit oriented messages. Existing messages are being translated into VMF formats and where necessary, new messages and/or new data elements are being defined. The Technical Interface Design Plan (TIDP) has identified a set of

VMF messages focusing on brigade and below digitization requirements outlined in the Operational Requirements Analysis for brigade and below. The TIDP has been submitted to the Joint Interoperability Engineering Organization for Joint approval.

A recent DOD policy designates the US agreed Link-16 data link as the DOD primary data link for all C2I and weapon systems applications, unless an exception is granted. A C3I Tactical Data Link Management Plan will be developed to enhance operational effectiveness of Joint and Combined forces; wherever possible, permit standardization of tactical C3I data links on the battlefield; and detail a migration strategy for data link waveforms and fixed and variable format message standards. The Army actively supports efforts of the Working Group to develop the C3I data link migration strategy and plan and is initiating assessments to determine the requirements for and to assess the feasibility of Link 16/VMF interfaces.

Near-Term Considerations for Battlefield Digitization
To date, lower-echelon information systems have been primarily messaging and display systems. As the evolving systems incorporate database capabilities and require seamless interoperability with command and control systems at brigade and above, there is a more pressing need for data standardization across the various battlefield information systems. The data element standardization efforts and the message standardization efforts will be integrated. Where standard data elements have been defined in the C2 Core Data Model, these will be used. As necessary, the C2 Core Data Model will be extended to accommodate additional data elements and relationships. The ultimate goal is to eliminate the need for message sets, such as character oriented USMTF, and do direct data base to data base transfers.

4.3.3.4 Human Computer Interface (HCI) Standard

Standardizing the HCI across application software to attain a user interface that presents a common appearance and behavior across Army systems requires a common set of HCI standards and a common approach to implementing them. The Army is developing guidance that will assure a common approach for systems that will be used to digitize the battlefield. This guidance will be contained in documents called "style guides."

Volume 8 of the DOD TAFIM contains the DOD HCI Style Guide. This style guide sets the basic standards for graphical HCIs for Army systems. However, the DOD Style guide is a general document that outlines the basic display standardization needs of the community. It does not therefore achieve the level of detail needed for truly interoperable systems that exhibit a common look and feel on the battlefield.

The User Interface Specifications for the GCCS define the "look and feel" of the user interface for GCCS applications. This "Style Guide" is focused on the Information Management and X-Windows environment of the GCCS community and supplements the basic guidelines in the DOD style guide to provide detail to assure that GCCS applications display a common look and feel across the GCCS platforms. The GCCS Style Guide is TAFIM compliant and references the DOD Style Guide.

The DOD HCI and AGCCS HCI Style Guides will set the basic interface standards for the ATCCS, FBCB2 and the other embedded system developers. However, in both of these style guides, the primary method of user interaction is through a graphical user interface (GUI). This standards profile also makes provision for an alternative mode of interaction, a character user interface (CUI) Applications that present graphical displays, such as maps, are accessible only through a GUI, however, applications that present non-graphical information, such as text, or tables of figures, can be accessed through either a graphical or character user interface. The benefit of a CUI is that it requires far less bandwidth. Since the bandwidth available to many battlefield users is very constrained, a CUI is necessary to provide them access to their essential applications.

4.4 Assessment Strategy

Continuous Evaluation Effort
Validation of the warfighting capability of forces equipped with digitization technologies can best be characterized as a continuous evaluation effort. This effort will be based primarily on timely and cost-effective assessments of validation and training exercises such as the major AWEs. The validation will also include the implementation of training programs and strategies, results from related operational and developmental tests, and the outcomes of modeling and simulation (M/S) efforts.

Early Identification of Problems
The ability to capitalize on opportunities for early testing, experimentation, and simulation in the Battle Lab environment will result in the early identification of problems and required solutions. From the beginning, the Army Analytic and Test and Evaluation communities will be involved in assessing the effectiveness of technologies, doctrine, procedures, and force structures. Operational Performance Objectives (OPO), Measures of Effectiveness (MOE) and Measures of Performance (MOP) are established within the Experimentation Master Plan (EXMP) to assess specific changes and track their effect over time. The measures of effectiveness focus on increases in force lethality, survivability, and tempo. OPO, MOE, and MOP will be validated by the Director, Joint Venture.

Integrated Experiments and Modeling & Simulation
The assessment is structured around a "rolling baseline" concept that integrates the experimentation and modeling and simulation efforts. M/S sponsored by the Louisiana Maneuvers Task Force (LAMTF) will be conducted by the TRADOC Analysis Command (TRAC) initially to establish thresholds for baseline MOEs using existing force structures and communications capabilities. The same model will be run using expected digital capabilities to establish initial MOE thresholds for a digitized force. Cumulative data from digitization experiments and exercises (ATDs, Advanced Concepts Technology Demonstrations (ATCD, BLWEs) will be used to calibrate the models. Once calibrated with this live exercise or experiment data, the models will be re-run to assess potential impacts of digitization on the force measures of effectiveness as well as looking at the synergistic effects between and within the BOS. Using calibrated M/S permits further examination of impacts caused by organizational changes versus those caused by digitization. It also supports an assessment of the effects of different employment concepts with the same systems, as well as varying scenarios and force structures. The major AWEs will be used to validate the M/S thresholds established for lethality, survivability, and lethality measures of effectiveness.

Cyclic Process
This cyclic process supports the ADO's evaluation of the value-added by digitization, while minimizing the need for large scale, costly field experiments and exercises. The TRADOC-led Analysis Experimentation Planning Group (AEPG) will be the forum to facilitate the close coordination and cooperation needed among the M/S, system developer and test communities.

4.4.1 Experimentation and Evaluation

EXMP
An initial EXMP, prepared by PEO-CCS, will guide the experiments for assessment of the applique through Brigade Task Force XXI. The Army's Independent Evaluators, Army Materiel Systems Analysis Activity (AMSAA) and Operational Test and Evaluation Command (OPTEC), in conjunction with the ADO, materiel developer, TRADOC, AMC (CECOM), and Forces Command (FORSCOM) will optimize evaluation support of the battlefield digitization effort through the EXMP.

Experimentation and testing of digital information technology will be designed to determine adequacy of requirements, to identify the best use of new capabilities, and to collect data necessary to provide credible evaluations in support of procurement decisions. Continuous evaluation through scheduled constructive, virtual, and live experiments and other separate, operational, and technical testing will verify equipment progress toward meeting mission needs

and performance objectives.

AWEs and BLWEs
The Army, through its Joint Venture Campaign Plan, will conduct a series of experiments to demonstrate improvements in force effectiveness as a result of fielding digital-information technologies, and by changing organizational designs and tactics, techniques, functions, and procedures. These experiments, called AWEs and BLWEs, will be designed to provide insights and yield data to both address operational force effectiveness and system-level performance issues. Applique and ATD equipment will be examined in these experiments to establish an early understanding of their warfighting potential. Each experiment will build upon the results of previous experiments, creating the "rolling baseline" assessment to measure force effectiveness increases.

Opportunities for data collection will occur in the course of fielding battlefield digitization equipment to the Joint Venture experimentation force (EXFOR). For example, during scheduled individual, crew, and collective training on the operation and use of the equipment, data will be obtained on both system performance and suitability. By taking advantage of these opportunities, the need for separate operational and technical tests should be diminished.

Five Classes of Experiments
In general, there will be five classes of experimentation and testing conducted to support the development and evaluation processes:

1) Integration Laboratory Certification-Preliminary examination of prototype hardware and software to verify ability to perform critical functions and meet interoperability requirements. Lead is AMC (CECOM) with participation from ADO, AMC (AMSAA), TRADOC and OPTEC.

2) BLWE-Virtual, constructive, or field event to examine new equipment, processes, and force design issues. BLWEs should provide significant opportunities for rigorous data collection to satisfy evaluation requirements. Lead is TRADOC with participation from OPTEC, ADO and AMC's (AMSAA and CECOM).

3) AWE-Major event conducted in a tactically rigorous environment to confirm experimental hypotheses regarding increases in warfighting capability. System-performance data collection during these events will be limited to minimize interference with training, realism, and other objectives. Lead is TRADOC with participation from OPTEC, ADO and AMC's (AMSAA and CECOM).

4) Technical Test (TT)-Event conducted to confirm that critical technical parameters and contractual specifications have been met, and also to examine system performance in especially stressful and controlled environments. These events will be conducted as necessary after successful Integration Laboratory certification and in parallel/coordination with BLWEs and Operational Tests. Lead is AMC (AMSAA) with participation from OPTEC, ADO, TRADOC and AMC (CECOM).

5) Operational Test (OT)-Event conducted to obtain data on total system performance when employed by representative soldiers in an operational environment. OT will be conducted as necessary to fill "data voids" in order to provide credible operational assessments for procurement and fielding decisions. Lead is OPTEC with participation from TRADOC, ADO, and AMC's (AMSAA and CECOM).

4.4.2 Modeling and Simulation (M/S) Strategy

Models
Models will be used throughout the digitization program to evaluate Operational and Technical Architectures, alternative technologies, interoperability, and force effectiveness issues. These

models and simulations are categorized as either constructive, virtual, or live. Combinations of these provide the most complete environment possible in which to examine digitization.

Constructive models and simulations require little human interaction during operation. A majority of system performance, network assessment, and force-on-force combat models fall into this category. Virtual simulations use manned simulators sharing "real" world computer generated images that require extensive interaction by participants. Live simulations are categorized as experiments, training exercises, demonstrations, and tests that take place in a field-like environment.

An objective simulation environment is needed to support digitization efforts. This objective environment integrates system performance models, constructive models, and virtual simulations through the use of distributed interactive simulation (DIS). Common representations of system and technology performance, architecture designs, network components, and environmental impacts (e.g., electronic warfare) across all simulation categories will provide a "seamless" evaluation environment. Data requirements to properly calibrate the models must be clearly identified by the M/S organization and the data collected by the test agency. AMC (CECOM and STRICOM) will orchestrate and coordinate modeling and simulation efforts to insure a logical flow of simulation experiments that are supported by meaningful network assessment, system performance and DIS.

Simulation
All models and simulations used to support the ADO assessment of digital communications are to be Verified and Validated (V&V) by the sponsoring/developing organization, as well as accredited by the using organization. This requirement for V&V includes combinations of separate models, such as a digital radio model interacting with simulators in DIS.

Four Classes of M/S
In general, there will be four classes of M/S to support the development and assessment processes:

1) The simulations that are part of the DIL at AMC (CECOM)'s Research Development and Engineering Center (RDEC) will be used to support system engineering and integration efforts. The DIL will permit hardware and software developers to test products in a realistic communications environment early in their design to enable redirecting development or eliminating inappropriate concepts. This capability supports the ADO plan for decreased system development time and evaluation of future technology insertions. The AIN, a critical aspect of the DIL, will be used to help resolve interoperability issues.

2) AMC (CECOM RDEC) and the TRADOC Battle Labs will use DIS, such as Simulation Networking (SIMNET) and Battlefield Distributed Simulation-Developmental (BDS-D), in conjunction with system and network performance models to the maximum extent possible to answer questions relating to the man-machine interface, use of digitally provided information, concepts of employment, acquisition, and fielding.

3) Network assessment models and simulations will be used to examine both the Technical and Operational Communications Architectures. The TRADOC's BCBL, will use Operational Architecture models to investigate operational considerations over a multiple number of communications networks simultaneously. These models assess information flow and communications means, development and portrayal of mission thread paths, mission timelines and variables, insights of system integration and interoperability, and identification of architecture redundancies. These models will examine and develop techniques for insertion of new protocols or modifications to existing transmission facilities and systems

4) Constructive force-on-force M/S is a primary factor in the "rolling baseline" assessment concept proposed for Force XXI and described in paragraph 4.3 in the overall Assessment Strategy. This cyclic modeling process supports the ADO's evaluation of the value-added by

digitization, while minimizing the need for large scale, costly field experiments and exercises.

4.4.3 Battle Labs

The TRADOC Battle Labs play key roles in refining the requirements for digitization and in defining the operational concepts and doctrine that will allow the Army to optimize the combat application of these technologies. The Battle Labs participate throughout the development process developing and validating digitization requirements, providing technology assessments and evaluating alternative tactics, techniques, and procedures. Battle Labs work closely with the operational test community to develop suitable test scenarios. Battle Labs conduct experiments and sponsor new technology into exercises as part of their requirements development process. Battle Labs are key participants in defining Force XXI objective requirements through experimentation in ATDs, AWEs, and exercises such as Prairie Warrior and Mobile Strike Force.

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Army Digitization Master Plan (ADMP)

CHAPTER 5 - JOINT/COMBINED INTEROPERABILITY

5.0 JOINT/COMBINED INTEROPERABILITY

5.1 Introduction

Why Interoperability
The Army fights as part of an air, sea, space, and land team. In modern warfare, Joint and Combined force operations increase in complexity. These operations demand improved information systems, with seamless interfaces, for the Army Warfighter to obtain the information to conduct offensive and defensive operations, and Operations Other Than War (OOTW). This requirement for interoperability on the digitized battlefield is further stipulated in DoD Directive 4630.5, which states that all Command, Cont rol, Communications and Intelligence (C3I) systems developed for use by US forces are considered to be for Joint use. By achieving interoperability through a common Technical Architecture, with common protocols, the Joint and Combined forces commander will have a clear and accurate vision of the battlespace.

5.2 Joint Interoperability

Current Status of Joint Interoperability
The Joint Staff developed "C4I for the Warrior" concept as a Joint interoperability objective. This was derived from Joint operational requirements. This concept creates a broadly connected Joint system of Joint systems that provides total battlespace information to the warrior and is entitled the Global Command and Control System (GCCS).

Each Service has implemented a framework to meet and conquer the challenges of Joint interoperability by synchronizing its Command, Control, Communications, Computers and Intelligence (C4I) programs with the "C4I for the Warrior" concept. The resulting strategy frameworks are called "The Enterprise Strategy" for the Army, "Horizon" for the Air Force, "Copernicus" for the Navy, and the Marine Air Ground Task Force C4I (MAGTF C4I) for the Marine Corps. Each Service's strategy is focused on achieving int eroperability through strict adherence to the Technical Architecture standards established by DoD.

Arm Digitization Office (ADO) Focus
The focus of the Army to attain Joint interoperability on the digitized battlefield has three components. The Army and its sister Services are migrating their current C4I systems to the Joint "C4I for the Warrior" concept. In accordance with the migration, the ADO will coordinate Army efforts to ensure that the Army Technical Architecture for information systems accommodates the provisions of the DoD Technical Architecture Framework for Information Management (TAFIM) - the common Technical Architecture of the Joint community. Second, the ADO will closely coordinate digitization efforts, to include the review and approval of information standards and data transport profiles with sister Services, the Joint Staff and Office of the Secretary of Defense (OSD) through memorandums of agreement (MOA), and proactive participation in Joint working groups and those pertinent panels that comprise the Military Communications-Electronics Board (MCEB). To ensure senior level involvement from the other Services, the H orizontal Technology

Integration General Officer Working Group (HTI GOWG) will invite appropriate flag rank personnel from the sister Services when Joint interoperability issues are scheduled for discussion. Third, other Services will be invited to participate in planned experiments, such as Advanced Warfighting Experiments (AWEs) and Battle Lab Warfighting Experiments (BLWEs). These experiments will be used to address, evaluate, and resolve interoperability effectiveness issues.

The key to combined interoperability is the information standards and data transport profiles that comprise the "interoperability" components of information Technical Architecture. Once these structures are agreed to by the MCEB process, it will be presented to the appropriate international forum. However, since there are numerous fora currently established in the international community, the selection of the pertinent forum will be predicated on the following criteria: political situation, resource c apacity, future intelligence implications, and extent of ongoing digitization efforts.

5.2.1 Management and Coordination Structure

Work within the Established Structure
Due to the authority invested in it to "obtain coordination on military communications-electronics matters among DoD components..." the MCEB is the key organization to obtain resolution of interoperability issues. Therefore, the ADO will work within the MCEB structure of functional panels and working groups to obtain Joint/OSD approval of Army digitization interoperability efforts. Since the MCEB review/approval process is extensive and lengthy, the role of the ADO will be to obtain consensus among th e Services through memorandum of agreements, working groups, and fora of flag rank level personnel, prior to submission of the issue to the MCEB process. This "frontloading" of the review/approval process is necessary to ensure the Army of the 21st century can interoperate with the other Services as expeditiously as possible.

Memorandum of Agreements
MOAs will be utilized to focus the interoperability efforts between the Army and each of the other Services. The MOA expresses each Service's senior leadership full support of achieving interoperability on the digitized battlefield. The MOA also defines the focus of the individual Service digitization effort and describes the management structure used to monitor, coordinate, and guide the efforts of each Service to achieve Joint interoperability.

Migration to the common operating environment (COE)
The objective of each MOA will be to establish a mutual goal of cooperative development, a management structure, and specific agreements to achieve interoperability through the common operating environment (COE). As defined earlier in this plan, the COE is the common hardware and software infrastructure to support a diverse set of mission area applications. Efforts are underway to define and evolve a COE, both within the Army and in the Joint arena. The efforts of each Service are interrelated, allow ing Service-specific mission applications ensure interoperability among all Services.

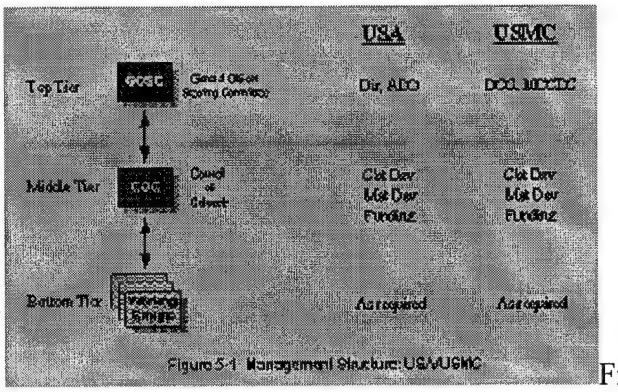

Figure 5-1. Management Structure: USA/USMC

Management Structure

A three tier management structure will be utilized to identify issues and problems requiring resolution. The top tier, a dual Service General Officer Steering Committee (GOSC), will be responsible for providing direction to the overall interoperability efforts of the two Services. It will also resolve conflicts and establish priorities. Membership in the GOSC will be defined in the MOA. The GOSC will meet as required. Periodically, the GOSC will hold a review of selected programs from both Servic es to ascertain the progress of battlefield digitization interoperability. The figure above depicts the management structure as defined in the USA/USMC MOA (draft) with the Director, ADO and the Deputy Commanding General, Marine Corps Combat Developments Command (MCCDC).

The middle tier consists of a Council of Colonels from both Services. This Council will be responsible to identify issues and problems, make recommendations to the GOSC, and ensure that the GOSC's direction is fully implemented. Minimally, the Council will meet quarterly. Membership, at a minimum, will consist of a materiel developer, a combat developer and a budget/funding member from each Service. Additional Colonels/GM15s can attend as non-voting members.

The bottom tier will consist of the working groups, comprised of action officers and subject matter experts from both Services. These working groups will be responsible to the Council for day-to-day monitoring of digitization efforts, and collection of data to answer GOSC and Council questions. These ad hoc working groups will be formed as required by the Council.

Liaison
As part of the MOA, the other Services will be authorized and encouraged to conduct direct liaison with Training and Doctrine Command (TRADOC), Army Materiel Command (AMC), Operational Test and Evaluation Command (OPTEC), and the Army Acquisition Executive (AAE) structure for technical and user/operational requirements exchange to further define and scope unique interoperability tasks and requirements. Additionally, both the ADO and the other Service will effect liaison with each other to ensure frequent opportunities for dual Service interaction and expeditious resolution of prob lems, issues, and conflicts.

Joint Battlefield Digitization Management
There exists already two fora to identify and resolve interoperability issues and problems. The first forum is the HTI GOWG. The other Services attend the GOWG meetings when Joint issues are discussed. It is the venue for addressing Joint Interoperability issues not covered by or in conflict with the policies and procedures in each dual-Service MOA. Additionally, it is the final authority to review and approve the Joint position prior to submission to the MCEB review/approval process.

The other forum identifying and resolving interoperability issues is the Joint Battlefield Digitization Council of Colonels/Captains (JBD COC/C), consisting of 06/GM15 representatives from each Service, OSD, and the Joint Staff. The JBD COC/C gathers data, evaluates positions on issues and makes recommendations to the HTI GOWG.

To reiterate, the MCEB is the key organization to attaining resolution of interoperability issues. The panels that make up the MCEB are functionally oriented, to include: C4I interoperability improvement, data systems interoperability, frequency control, information systems security, interoperability testing, and standards coordination. Army representatives, normally from the Office of Director of Information Systems for Command, Control, Communications and Computers (ODISC4), sit on applicable panels , while the Director of Information Systems for Command, Control, Communications and Computers (DISC4) and Director of the ADO are members of the MCEB. This Army representation ensures proper and effective support of "frontloaded" Army and sister Services' position on Joint interoperability issues addressed in the MCEB review/approval process. Focus of the ADO in the MCEB will be the resolution and approval of information standards (i.e., data elements, Variable Message Format (VMF) message standards, etc .) and data transport profiles (Transmission Control Protocol (TCP)/Internet Protocol (IP), systems profiles, etc.).

5.2.2 Joint Initiatives and Experiments

Army Warfighting Experiments
The ADO will utilize planned digitization experiments to evaluate and assess Joint digitization efforts. The first target of opportunity is the AWE Task Force XXI in 1997. The major Army goals of this AWE will be to document the improvements in survivability, lethality, and operational tempo. The exercise will also provide insights to the Army in terms of division and corps command and control. Once the analysis of Task Force XXI is completed, it will become the rolling baseline for future exercise comparisons.

All other Services have been invited to participate in Task Force XXI, with initial focus on Marine Corps and Air Force participation. Though the extent of each Service's participation is still being defined, each will receive a sufficient number of software and hardware appliques through the Army's Research, Development And Acquisition (RD&A) contract to ascertain interoperability connectivity and compatibility. Based on the results of this AWE, a baseline for Joint interoperability will be establish ed, to be used as a comparison for Joint interoperability during follow-on AWEs.

It is the Army's intention to make full use of the Joint Warrior Interoperability Demonstrations (JWIDs) to test interoperability on the Joint digitized battlefield.

Joint Warrior Interoperability Demonstrations
JWIDs are a series of Joint Staff sponsored interoperability demonstrations. JWID is a complex undertaking that brings together the Services, federal agencies, and commercial vendors. Interoperability and Joint operations are the fundamental goals of these demonstrations - goals that are intended to advance the "C4I for the Warrior" concept.

JWID '95 is sponsored by the Marine Corps and will be held in September 1995. The primary objective of JWID '95 is to demonstrate the interoperability of existing and emerging C4I systems employed in a Joint Task Force deployment scenario. The Marine Corps will use this opportunity to exercise its MAGTF C4I systems strategy. It is built on the Joint Maritime Command Information System (JMCIS) unified build software and the GCCS COE. The Army will take advantage of the excellent opportunity presented by JWID '95 to assess interoperability between MAGTF C4I systems and the Force XXI Battle Command Brigade and Below (FBCB2).

Digital Battlefield Initiatives Concepts
There are many opportunities for leveraging from digitization programs of other Services. The ADO will closely coordinate with the other Services to identify these digitization initiatives and concepts. Currently, the Air Force has identified approximately seventy-five concepts that apply to the digitized battlefield. These concepts run the gauntlet of functions, including communications, navigation, identification, information management, and Local Area Network (LAN)/Wide Area Network (WAN). All ot her Services are being surveyed for potential digital battlefield concepts. All concepts will be evaluated by the Army for possible inclusion in AWEs and/or Advanced Technology Demonstrations (ATDs). All data will be made available to other Services through the management and coordination structures previously described.

Digital Integration Laboratory (DIL)
Under the auspices of AMC Communications and Electronics Command (CECOM), the Digital Integration laboratory (DIL) provides the preliminary examination of, prototype hardware and software to verify ability to perform critical functions and meet interoperability requirements. The DIL is being made accessible to all the other Services, with the Marine Corps slated to be the first to connect to the DIL. Additionally, the DIL will be connected to selected Allied partners. Utilization of the DIL will be b ased on a concept of "build a little, test a little."

5.3 Combined Interoperability/International Strategy

Vision/Goal
The ADO's vision in Multinational Force Compatibility (MFC) is to support our allies as required to successfully prosecute joint and coalition warfare and in OOTW. The goal in international cooperation is to establish and implement a basic strategy that supports coalition warfare through interoperability with our allies and provides for cost effective technology solutions for materiel development through international technology leveraging.

Secretary of Defense Perry, in his policy memorandum of June 25, 1993, called for a renaissance in armaments cooperation:

DoD Policy
"As we address issues of defense reinvestment and as our armed forces and those of our allies draw down, it is critical that we look for every opportunity to increase the effectiveness of those forces while making the most efficient use of the resources we apply to our collective defenses. I believe that armaments cooperation can be a primary means of achieving those ends. .."

In support of Secretary Perry's policy and in realization of the current geopolitical environment, the ADO supports those MFC and technology leveraging programs that enable the Army to perform effectively in joint and coalition warfare and in OOTW.

The International Digitization Strategy (Annex K) is designed to provide our key Allies with current and consistent information on US Army digitization efforts. This will facilitate the establishment of collaborative efforts to develop doctrine and systems that are capable of interoperation. In addition, the strategy will provide an overarching framework for coordinating the leveraging of advanced and emerging technology that will enhance the ability of both the US and its Allies to field inherently in teroperable systems. For our forces to successfully operate in a multinational conventional war environment, as well as OOTW, the following will be required:

- Harmonization of national doctrine, tactics, and techniques in support of coalition warfare.
- Implementation of cooperative programs in systems development, technology, and standards.
- Execution of multinational evaluations of operational concepts, architectures, standards, systems and technologies that are evolving from the cooperative international efforts being undertaken by TRADOC and the Battle Labs, AMC Research Development & Engineering Centers supported by the Army Research Laboratory, PEO/PM's, sister Services, commercial development and academia research.

Multinational interoperability will be pursued by extending the Army Digitization Campaign Plan to include selected Allied countries. The Army Digitization Master Plan International Strategy (Annex K) incorporates the following efforts:

- Establish a common basis of understanding of the necessary process leading to digitization. This includes architecture definitions, the architecture development process and the digitization campaign plan.
- Develop specific "digitization" cooperative programs with major Allies in order to leverage and share the development of technology, and where possible, components, systems, processes and standards required for digitization.
- Utilize commercial standards which are accepted internationally to achieve an open systems architecture.
- Systematically define and implement a Technical and System Architecture as well as developing and fielding hardware/software solutions to provide for seamless information flow in a coalition warfare environment.

- Utilize selected existing agreements and international fora with major Allies and focus their work toward achieving "digitization" goals.
- Achieve command and control (C2) interoperability with Allied units by defining country unique operational and doctrinal concepts and procedures.
- Use existing key international fora to promote harmonization. (Selected fora will be identified and prioritized so that the US position can be presented in a consistent and cohesive manner.)
- Leverage foreign technology through international agreements. The proliferation of technology worldwide provides for selected opportunities to leverage and jointly pursue in a "quid pro quo" arrangement.
- Push the state of the art for the doctrine associated with the international aspect of digitization. This includes the changes in doctrine which will be needed to accommodate the rapid exchange of information vertically through echelons and horizontally between functional areas and combat platforms.

These efforts form the basis for achieving multinational force compatibility through digitization as depicted in figure 5-2.

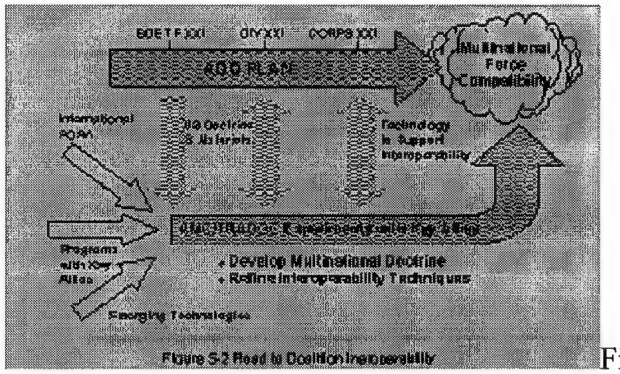

Figure 5-2.

5.3.1 Major Allied Efforts

There are no known specific major Allied efforts of the magnitude and scope of the US Army battlefield digitization program. Some countries, notably Germany, United Kingdom (UK), and France have expressed an interest in the US program. However, it is not believed they have made a significant resource commitment to implementation. The commercial market in these countries has the potential to provide the technology needed to support a digitization effort, should the military choose to make the inves tment. Several countries are making investments at the technology base level to support digitization initiatives. There are related efforts in the area of lower level command and control which are utilizing digitization. These efforts have similar objectives as the US Combined Arms Command and Control program, which include:

- Germany - GeFuSys - An all arms system attempting to provide horizontal integration of artillery, engineers, air defense, army aviation, and armored troops.
- France - SIR - A command and control system being developed for regiment and below.
- UK - BICS - The Battalion Information Command and Control Information System (BICS) is primarily a conceptual study to determine the feasibility and cost effectiveness of a lower echelon C2 system. BOWMAN combat net radio is currently under development and expected to be fielded in the near term.

5.3.2 International Cooperative Initiatives

To attain the objectives of this strategy, we will coordinate and cooperate with our key Allies to define, develop, test, and field systems with effective and interoperable capabilities. Through technical discussions under various bilateral (e.g. Data Exchange Agreements (DEAs), Communication-Electronic Working Groups (CEWGs), etc.) and multi-lateral (e.g. America Britain Canada Australia (ABCA), Senior National Representative Army (SNR(A)), North Atlantic Treaty Organization (NATO)) fora, numerous co operative efforts have been formulated and are in the various stages of the MOU review/approval/implementation process.

5.3.3 Ongoing Programs

The identified projects which are addressing "digitization" efforts as their primary focus are briefly described. Army Tactical Command and Control Information System (ATCCIS) provides an architectural framework for NATO in the near and mid term. Combat Identification is narrowly focused on solving the fratricide problem. It is a multi phased program extending beyond the year 2000. Implementation of the mid/far term solution will in most likelihood involve digitization techniques which need to be int egrated into the overall digitization program. The International C2 Systems Interoperability Project will provide the capability to link, initially with Germany, Allied systems with the AMC CECOM DIL and the Battle Labs to provide a capability for demonstration and experimentation. Future plans are to extend the effort to France and the UK in the mid term and later other key Allies.

5.3.4 Technology Leveraging Opportunities

In addition to the Army's goal of Multi-National Force Compatibility in international cooperation, there is also the goal of establishing and implementing a basic strategy of technology leveraging. Leveraging refers to activities that multiply the effects of US investments in technology by taking advantage of the investments made by others. Participation in international cooperative research and development R&D in key technology areas offer high payoff opportunities for leveraging US investments with t hose of our Allies. Such leverage will help maintain US technological advantage, stimulate battlefield interoperability, and sustain our economic competitiveness through the subsequent development of dual-use technology products.

The Army Science and Technology Master Plan identifies foreign technology trends in the following areas denoting strong capabilities with specific opportunities:

- France - Communications, real time artificial intelligence (AI), photonic devices for optical computing.
- Germany - Communications software.
- Japan - Fuzzy Logic.
- Israel - battle management software.
- UK - gallium arsenic (GaAs) components.

Future programs will be developed to leverage information technology and expertise in digitization from both domestic and foreign government laboratories, industries and academia. To accomplish this the Army will:

- Identify critical information and communication technologies through worldwide technology assessments.
- Encourage industry to industry, academia teaming arrangements that allow the leveraging of

foreign research and technology in identified critical technologies.

- Develop cooperative agreements and exchange research data and information under the auspices of Technology Working Groups, NATO, and the Technology Cooperation Program.

The Army Research Laboratory Federated Laboratory initiative will be used to leverage key technology available in the international market.

5.3.5 Challenges

There are unique challenges which must be addressed in the implementation of an international digitization program. These are:

- Different doctrine. Each country operates with their own set of doctrine which inhibits the seamless integration of multinational forces. Different force structures are often used which effect the command and control aspects.
- Different C2 Automation capability. The command and control systems utilize different computers, software, operating systems. Through the use of commercially based systems and standards, this challenge can be met.
- Technology differences. System upgrades provide a problem of interoperability. It may not be practical to achieve compatibility with systems which are displaced by several generations of technology.
- Communications interoperability is a challenge. Programs such as the Multi Programmable Interface and the SPEAKEASY, with its programmable waveform capability, are needed to address this issue.
- Financial constraints on the US and Allied sides. Most countries are in a declining defense environment which leaves scant resources for upgrade programs.
- Political and economic. Each country has its own national political and economic goals which may drive it to certain non-optimal solutions and adoption of unique products which reduce the opportunity for interoperability and cooperation.
- Security issues constrain the degree and open exchange of information. Different security implementations among nations complicates the issue further.

These challenges will be met in developing international digitization programs.

This strategy as presented allows for the formulation and execution of a consistent Army international strategy for digitization utilizing existing international fora whenever possible. By taking this integrated approach to international cooperation, concentrating on interoperability and technology leveraging, the US Army can present a single coordinated policy to our allies and adversaries in digitizing the battlefield.

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Army Digitization Master Plan (ADMP)

CHAPTER 6 - MANAGEMENT

6.0 MANAGEMENT

6.1 Army Digitization Office (ADO)

The ADO is responsible for the management and coordination of the Army's digitization effort. To accomplish its assigned mission, the ADO is organized in four functional teams as shown in the chart below:

Figure 6-1

6.2 Responsibilities

6.2.1 Integration Team

Integration Team
As the Operations cell for the ADO, the Integration Team is responsible for coordination of Army digitization policy and strategy. It also serves as the principal integrator of digitization policy within the Army and coordinates with agencies external to the Army.

Within the Army, the Integration Team coordinates digitization strategy with the Louisiana Maneuvers Task Force (LAMTF) and Army Major Commands (MACOMs) in support of the Force XXI modernization effort. It serves as the primary interface with the Army Secretariat, Army Staff (ARSTAF), MACOMs and Army agencies on digitization policy and strategy matters. The Team also coordinates the integration of digital capabilities within Advanced Technology Demonstrations (ATDs) and Advanced Warfighter Experiments (AWEs).

External to the Army, the Integration Team is the primary coordinating arm for the ADO on all matters concerning Joint and Allied digitization strategy and policy. The integration team also prepares all Congressional correspondence, digitization briefings and organizes conferences for the Director.

With respect to industry, the Integration Team investigates proposed Battle Lab and commercial technologies that have impact on the digitization effort. It also provides information to industry on the major thrusts of digitization.

The Integration Team compiles and maintains a list of all issues/requirements identified as part of the digitization process. There also are many other fora to identify issues and problems requiring resolution. As issues are identified in the Digitization Council of Colonels/Captains, the Horizontal Technology Integration General Officer Working Group (HTI GOWG), and the periodic review with Program Executive Offices (PEOs)/Program Managers (PMs), any issues/problems requiring resolution will be added to the issue tracking process. In addition to internal Army processes, the ADO participates in several Joint fora such as the Military Communications and Electronics Board (MCEB). Any issues relating to Joint matters will be

surfaced in this forum. Joint issues are not only addressed in the Digitization Council of Colonels/Captains, but also by two star representation from all Services at the HTI GOWG. These issues are evaluated, prioritized, and assigned to an organization or agency for resolution. The Team verifies that identified issues are being adequately addressed and resolved.

Finally, the Integration Team creates and maintains policy documents. Most important of these is the Army Digitization Master Plan (ADMP) which provides the roadmap for future digitization efforts. It also coordinates the Digitization Master Schedule, which integrates the schedules of major Army systems and technologies that have a direct impact on the digitization of Force XXI.

6.2.2 Requirements and Evaluation Team

Requirements and Evaluation Team
The Requirements and Evaluation Team supports the Army digitization axis by coordinating user requirements, test, evaluation and experimentation issues for the digitized battlefield. This process involves liaison with Training and Doctrine Command (TRADOC) and the ARSTAF to define and resource user requirements and coordination with the materiel developers, combat developers and the test and evaluation community to validate hardware and software items identified to satisfy those needs. The Team is responsible for supporting the Joint Venture axis of the Force XXI campaign plan by monitoring and coordinating battle command digitization issues for the Brigade Task Force XXI, Division XXI and Corps XXI Advanced Warfighting Experiments (AWEs) and supporting exercises.

Specifically, the Team is responsible for monitoring the development and approval of requirements documents that impact battlefield digitization. The current requirements documents include: the Horizontal Integration of Battle Command Mission Needs Statement (HIBC MNS), the Army Battle Command System Common Operating Environment/Common Applications Operational Requirements Document (ABCS COE/CA ORD), and the Force XXI Battle Command - Brigade and Below Operational Requirements Document (FBCB2). The Team is the ADO's point of contact for all requirement s documents that affect the Army digitization effort.

The Requirements and Evaluation Team interfaces with the test and evaluation community to develop the methodology to ensure sufficient analytic rigor exists to justify procurement decisions. This requires close coordination with Headquarters, TRADOC to determine what operational performance objectives are important to meet in various AWEs. As such, the team represents the ADO on the Analysis and Experimentation Planning Group (AEPG) which is responsible for developing a coordinated, consolidated evaluation plan for major experiments. The Team is a major player in the development of the digitization Experimentation Master Plan (EXMP), a document similar to a Test and Evaluation Master Plan (TEMP) that articulates the methodology to meet Task Force XXI AWE objectives. The EXMP will be updated to reflect remaining issues to be addressed during both the Division XXI and Corps XXI AWEs.

An additional area of responsibility is integration of modeling and simulation into the analytic and experimentation framework. The Team monitors the ongoing development of the Synthetic Theater of War (STOW) model and ensures upgrades are made to existing command, control and communications models/simulations.

Other areas of involvement include participation in various Force XXI process action team meetings for AWEs, LAMTF Synchronization Working Group meetings, C3I models and simulation, and Distributed Interactive Simulation standards committees. The Team also monitors Battle Lab digitization initiatives and availability of modernized and digital equipment in the Experimentation Force (EXFOR).

6.2.3 Acquisition Team

Acquisition Team
The Acquisition Team is responsible for resource management, acquisition planning oversight and

the streamlining of the acquisition process in support of the Force XXI digitization effort. The Acquisition Team recommends, maintains and updates planned digitization program funding by use of a digitization Management Decision Package (MDEP) to include program execution of its own budget lines. The Team ensures the funding outlined in the MDEP is programmed, budgeted, and executed in a manner consistent with the ADMP and established Army priorities. In addition, the Acquisition Team coordinates the MDEP with the ARSTAF, MACOMs, PEOs and PMs. The results are briefed to the Army Acquisition Executive (AAE) and Vice Chief of Staff of the Army (VCSA). The PEOs/PMs must inform the ADO when resource allocation adjustments occur within the MDEP. In a collaborative effort, the ADO, MACOMs, and PEOs/PMs recommend adjustments to the MDEP which best meet the needs of the Army digitization effort. The MEP includes funding for various R&D Program Elements (PEs) and procurement Budget Line Identification Numbers (BLINs) related to digitization.

The Acquisition Team will periodically conduct technical and program execution reviews. Acquisition reviews will be conducted on all key contracts directly related to Force XXI digitization. The release of program funding contained in the digitization MDEP will be contingent on completing these reviews. PEOs/PMs will provide copies of status reports required by parent organizations to the ADO in the same format and frequency required by their higher headquarters.

The Acquisition Team will ensure a streamlined approach in the digitization acquisition strategy throughout the Force XXI modernization process. This approach will be characterized by intense management of resources. Close coordination with TRADOC and the materiel developers will ensure real time responses to user needs through appropriate adjustments to acquisition plans and procurement actions. Identification of commercial non developmental items where practical, maximum consideration of commercial standards and practices, and leveraging of ongoing acquisitions by participating platform managers are examples of the common threads in this streamlined acquisition approach.

The Acquisition Team also provides general administrative, budgetary and logistics support to the ADO on a daily basis.

6.2.4 Architecture Team

Architecture Team
The Architecture Team serves as the focal point for all digitization technical efforts. The Architecture Team coordinates technical issues with the PEOs, the Army Materiel Command (AMC), Space and Strategic Defense Command, Ballistic Missle Defense Organization, Army Medical Command, and the materiel developers from the Marine Corps, Navy, and Air Force. The Team has sufficient technical expertise to provide the Army Secretariat with independent technical assessments of digitization issues.

The Architecture Team is specifically responsible for ensuring that the development and implementation of the System and Operational Architectures conform to the Army's Technical Architecture. The Team actively works with the Director of Information Systems for Command, Control, Communications, and Computers (DISC4) and the AMC Communications and Electronics Command (CECOM) System Engineering Office to coordinate and review the continued development of the Army's Technical Architecture. The Team reviews the Technical Architecture to ensure commercial standards and practices are used in the development of common protocols and standards, and that the Army is representated at military and commercial standards bodies. The Team also enforces the application of the Technical Architecture in all related digitization projects to include embedded systems such as the M1A2 Tank and the AH-64 Helicopter programs.

The Team works with the Signal Center, PEO Communications, and AMC (CECOM) to plan for the development of the Tactical Internet and the evolution to the Battlefield Information Transmission System (BITS). The effort includes the review of modelling data conducted by PEO

Communications and the Signal Center, reviewing system architecture technical details, and ensuring that adequate system integration and testing is performed before equipment is fielded to the exercise force.

Additionally the Architecture Team is responsible for ensuring that sound system engineering practices are being followed to include hardware and software configuration control, the creation of a Systems Engineering Management Plan, and the conduct of Preliminary and Critical Design Reviews.

"Success in the information age will go to those who have the courage to challenge themselves, who constantly innovate, and learn how to adapt as they go."

General Gordon R. Sullivan
Chief of Staff, United States Army


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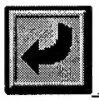
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